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THE HUDSON RIVER TUNNEL has been advanced approximately 3,700 ft. from the New Jersey shaft. Ironwork for the fourth bulkhead has been placed in position, and the entire work will be soon completed. It has been decided to abandon the attempt to drive a heading from the New York shore, for reasons explained in part in our issue of Nov. 7, 1890. At present the work has been slackened, but the full force of 150 men will be employed again shortly. The 2,000 ft. remaining to be tunneled is in firmer ground than has heretofore been encountered, and if the recent rate of advance of 10 ft. a day can be maintained, the New York shaft will be reached in about 7 months. But one of the two headings is being now worked on, it being thought that with the experience gained by completing the first one the second can be driven to better advantage.

THE CRIB OF THE LAKE VIEW WATER-WORKS TUNNEL was launched at Chicago, on May 7, under the supervision of Mr. A. W. COOKE, City Engineer, and Mr. B. FEIND, Principal Assistant City Engineer. Shailer & Schniglau, of Chicago, are the engineers and contractors for the work. The crib launched was 75 ft. in diameter and 13 ft. high. When completed it will be 40 ft. high. It will be located 10,000 ft. from the shore. The estimated cost of the crib is $80,000.

BIDS FOR THE CONSTRUCTION OF BUILDINGS for the Grant Locomotive Works at Chicago are said to have been called for. The plans were drawn by Reeder, Coffin & Crocker, and the cost of the buildings is estimated at from $250,000 to $300,000.

ANOTHER SERIES OF ARMOR-PLATE TESTS has just been concluded at Annapolis. The plates tested were 8 ft. long, 6 ft. wide, and 3 ins. thick. They were all rolled by Carnegie, Phipps & Co., and included one all-steel plate, two nickel steel plates with differing percentages of carbon, and two plates treated by the Harvey process, one of which was all steel and the other was nickel steel. This process is the invention of Mr. H. A. HARNEY, of Newark, N.J.; and it effects a variation in the character of the metal, that on the front of the plate having the highest carbon and being hardest, while the back of the plate is of soft and tough metal.

The tests were made by firing 21 shots at each plate from a 6-lb. Hotchkiss rapid-firing gun, placed close enough to the plate to give a striking velocity of 1,800 ft. per second. The projectiles used were forged steel armor-piercing projectiles, and most of those which rebounded were broken. The results of the test are given as follows by the press reports:

The all-steel plate was pierced by nearly every shot fired, and was badly cracked in addition. The low carbon, nickel steel plate was not cracked, but a large number of the shots passed through it. The high carbon, nickel steel plate made an admirable record. No cracks were developed and none of the projectiles pierced the rear surface of the plate. The greatest penetration was 3 ins., which caused merely a bulging of the back. The all-steel plate treated by the Harvey process was slightly cracked, but repelled every projectile, two only indenting it to the depth of 2 ins., the others being flattened against the plate. The Harvey nickel steel plate, however, made the best record; only one small crack developed, and that was at a point at some distance from the point where any shot had struck. No shot dented the plate more than ¼-in. Former tests of the Harvey process with a 10-in. plate and a 100-lb. projectile, resulting in several through cracks of the plate, were described in our issue of March 28.

A DRAWBRIDGE OVER THE PATAPSCO RIVER at Baltimore, Md., was opened May 12. The center span is 218 ft. long, and rests on a center pier which was somewhat difficult to build owing to the bad foundation. One hundred piles, 85 ft. long and from 20 to 23 ins. in greatest diameter, were driven in a 24-ft. square to a depth of 65 ft., and were then cut off 15½ ft. below mean low tide. On these piles was sunk a grillage of 12 × 12 in. Georgia pine, 29 ft. square and 14 ft. high. The pier itself is of marble, with granite coping. The draw was built by the King Iron Bridge Co., under the supervision of Mr. JOHN W. BOLLMAN.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment on the Sinnemahoning R. R., at Moore's Run, Pa., May 11. A trainload of men who had been fighting the forest fires was running through a part of the burning forest when it jumped the track, and the flat cars were thrown down the bank among the flames. The superintendent of the road and 6 of the men were burned to death, and several others were seriously injured. A head collision occurred May 7 on the Pittsburg, Cincinnati & St. Louis Ry., near Dennison, O. An eastbound passenger train and a westbound mail train ran into one another, wrecking both engines and the mail and baggage cars. The double track ends at this point, and the mail train ran on to the single track, owing, it is said, to a failure of the brakes. An Illinois Central R. R. express train was derailed near Duquoin, Ill., May 8, and five persons were injured.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: A trestle on the Canadian Pacific Ry., 50 miles west of Sudbury, Ont., was burned May 8, and caused the wreck of an express train. One man was killed and 2 of the cars were burned. The railway bridge across Bayou Vermilion at Lafayette, La., was damaged by fire May 8. A bridge on the Central Vermont R. R., near Chester, Vt., was burned May 9. An iron bridge of 300 ft. span, in course of construction at English Center, Pa., collapsed May 7, owing to a failure of the false works. A trestle on the Chicago & Western Indiana R. R. near Chicago, Ill., was wrecked by a derailed freight train May 7. The engine and 2 tank cars went down, the oil caught fire, and the cars and trestle were burned.

ESTIMATES OF COST of the Chicago drainage work differ all the way from 2 to 3 cts. to 25 cts. per cu. yd. for the dredging. A prominent contractor (Mr. HALEY) considered that the first 10 miles of the Michigan Canal could be dredged for 10 cts. per cu. yd. at the most, furnishing clay for 1,400,000 M. bricks; enough to supply the demand of Chicago for six years. The rock work Mr. HALEY considered could not be done for $1 per cu. yd., but we strongly suspect that if he had a contract for it at that figure thrown at him he would not throw it away.

IMMIGRATION for March was 52,172 against 35,750, an increase of 46%; for the 9 mos. ending with March it has been 316,237 against 254,403, an increase of 24%. Italian immigration was 15.3% of the total in March against 17.3% a year ago. For the 9 mos. of this year it has been 12% agaist 9.5% a year ago. Polish immigration, while small in quantity, shows a very marked tendency to increase. This is evidently to be a great immigration year, and the necessity of some check upon it is becoming increasingly evident.

THE TAMPICO HARBOR WORKS are progressing. According to the report of the Mexican Central Ry. Co., the trestle-work on the north jetty was completed 4,680 ft. from the shore, and the mattress-work was above water for 4,440 ft. of that distance on April 3; on the south jetty, at the same date, the the trestle-work was 3,270 ft. from the shore and the mattress-work 3,090 ft. The jetties are parallel to each other 1,000 ft. apart, the effective width being 900 ft. They are of trestle-work, built like an ordinary double-track railway trestle, with a hearting of mattress-work leveled down with stone. They run parallel to the current of the river, and, when completed, will be 7,000 ft. long each.

WATER-SUPPLY FROM ARTESIAN WELLS is attracting the attention of capitalists in the Central American States. A company organized at Leon, Nicaragua, has bored four wells in the vicinity of that town, and is supplying the inhabitants of Jinetepec and Diriamba with drinking water. The strata through which these wells are bored consists principally of lava and volcanic sand, the latter being rather difficult to penetrate; also very hard rock-layers of sand, with pebbles and strata of clay, are found. The water, which has to be pumped from 700 ft. to 800 ft., is said to be very good, and a great benefit to the people, whose only source of supply has hitherto been the brackish and stagnant water collected in pools during the rainy seasons. A charge of ¼-ct. per gall. is made for the water.

THE PANAMA CANAL EXTENSION granted to Lieut. WYSE by the Colombian government gives that gentleman till Feb. 28, 1893, to organize a company with sufficient capital to complete the work, the company then having till 1901 to finish it. Lieut. WYSE estimates the cost of completion with locks and an artificial summit lake of 20,000 acres at $120,000,000, which is the precise sum which M. DE LESSEPS originally estimated for a sea-level canal complete. There is not the remotest probability of that sum being raised, or of the canal being completed for it, if it is raised, the insuperable difficulty being the control of the Chagres River.

THE CANADIAN PACIFIC FAST RUN across the continent, described last week, has been fully reported to us from official sources.

The train left Vancouver at 6:10 P. M., Pacific time, or 9:10 P. M., Eastern time, April 28, and arrived in Montreal, May 2, at 5:40 P. M., Eastern time, having occupied 92 hours, 30 minutes, including a detention of three hours by a mud slide, so that the real time of the train was 89 hours 35 minutes. The time was comparatively slow over the section built by the Canadian Government, and several stops were made to enable passengers to view the scenery in the mountains.

The run from Donald to Port Arthur was made at the rate of about 37¾ miles per hour. The run from Port Arthur to Smith's Falls, exclusive of extraordinary stops, was made at 37 miles per hour. The actual running time from Smith's Falls to Montreal, 128.3 miles, was 2 hours, 5 minutes, or at the rate of 61.6 miles per hour.

NIAGARA FALLS is to be set to turning water wheels on the Canadian side as well as on the American. It is stated that capitalists connected with the London Electric Supply Corporation, Ltd., of Deptford, England, have agreed to begin operations for utilizing the power of Niagara on the Canadian side before March 1, 1892. The sum of $20,000 has been deposited with the Niagara Falls Park Commissioners of Ontario, to be forfeited if the agreement is not kept.

It is proposed to utilize this power to generate electricity of enormously high voltage, which will be transmitted to various cities for light and power purposes. The syndicate pay $25,000 per annum for their franchise for 10 years, the rental then increasing to $35,000 in the twentieth year.

THE ESTIMATED COST OF THE PRINCE EDWARD ISLAND TUNNEL has been stated by Sir DOUGLAS FOX to be as follows: Tunnel of 12 ft. diameter operated by electric motors, $5,000,000; tunnel of 18 ft., to be operated by locomotives, $11,000,000; tunnel of 16 ft., operated in same manner, $10,000,000.

Professor Julius E. Hilgard.

Professor JULIUS ERASMUS HILGARD, late Superintendent of the United States Coast and Geodetic Survey, and for nearly half a century prominent among the engineers and scientists of the country, died at Washington, D. C., May 8. The main facts of his distinguished career may be summarized as follows:

Mr. HILGARD was born in Zweibrücken, Bavaria, on Jan. 7, 1825, and in 1835 he came to the United States with his father, who was a lawyer and author. The family settled at Belleville, Ill., where he obtained his education under the guidance of his father. In 1843 he removed to Philadelphia, where he began the study of civil engineering. In 1845 he was appointed to a position on the United States Coast Survey, under Superintendent ALEXANDER D. BACHE. At the time of the war, when coast-survey men were busily engaged in work on the rivers and harbors, obtaining information for the naval authorities, Mr. HILGARD became principal executive officer under his chief, under the designation of assistant in charge of the office. This position he held under the two successors of Mr. BACHE, viz. Mr. BENJAMIN PIERCE and Mr. PATTERSON, and upon the death of the latter in 1881 he was appointed superintendent.

Meanwhile his scientific abilities and the results of his work had met with the approval of men of science. His work lay directly in the line of his profession, in the improvement of methods, the determination of weights and measures, and the novel method of ascertaining the differences of longitude by telegraph. It also consisted of researches and the discussion of results in geodesy and terrestrial physics and in perfecting methods and instrumental means connected with the same. His publications on these subjects are to be found chiefly in the Coast Survey Reports. One of the most noteworthy relates to the telegraphic determination of the differences of longitude between Greenwich, Paris, and Washington. He was a delegate to the International Metric Commission in 1872, and a member of the International Bureau of Weights and Measures, of which he declined the directorship. He was an original member of the National Academy of Sciences, and for some years its Home Secretary. In 1874 he was elected President of the American Association for the Advancement of Science. He succeeded Mr. BACHE in connection with the work of the Bureau of Weights and Measures, and took a leading part in preparing exact metric standards for distribution to the states and territories. The magnetic survey of the United States, carried out at the expense of the BACHE fund of the National Academy of Sciences, was placed under his direction.

In 1885, for reasons connected with political affairs and changes, Mr. HILGARD was suspended and then permitted to resign. Professor ALEXANDER AGASSIZ, who declined to succeed him, said, in commenting on the behavior of the committee of investigation: "Their dictum upon the late superintendent, at least as far as his professional career is concerned, is answered by his position as an investigator in the scientific world." Mr. HILGARD was prostrated by illness at the time, and the severance of his relations with the organization in which he had spent so much of his life, and for which he had done so much valuable work, was a severe blow to him.

His character sometimes led him, if his sympathies were excited, into hasty and ill-advised participation in other people's controversies, and he thus made enemies, and, in a measure, stood in his own path, but his character was thoroughly kindly, charitable and self-sacrificing, and his unpretentious daily life was adorned by many proofs of this, one of the greatest being his refusal to take the prize which was within his grasp of Superintendent of the United States Coast Survey at the expense of his old chief Prof. BACHE. To this also may be ascribed the almost quixotic way in which he sometimes aided the fortunes of his active professional rivals. He was an enthusiastic, indefatigable worker, quick to investigate and approve new methods, and, from his linguistic proficiency and wide reading, thoroughly informed on the progress of geodesy and engineering in foreign lands. A certain mannerism of speech and gesture ofter impressed unfavorably persons whose knowledge of him was but superficial, but counted for nothing with those who knew more intimately his noble qualities.

JULIUS ERASMUS HILGARD.

The Walnut St. Bridge, at Chattanooga, Tenn.

(WITH INSET).

The bridge illustrated on our inset sheet this week crosses the Tennessee river at Chattanooga, and affords access to Hill City, a flourishing suburb. The bridge was built by Hamilton County, Tenn., as a free highway bridge. That the traffic over it is sufficient to warrant its construction is shown by the fact that since its completion private parties have offered to purchase it for a toll bridge at a price $50,000 in excess of its total cost. The project for a bridge at this point was first agitated about seven years ago, but was opposed by members of the County Court. Finally, however, the opposition was overcome, largely through the efforts of Mr. R. M. BARTON, of Chattanooga, and the work was carried through.

The general plans and specifications were completed, and proposals for building the bridge were called for in the latter part of May, 1889, and on July 10 contracts were let to Neely Smith & Co., of Chattanooga, for the substructure, and to the Smith Bridge Co., of Toledo, O., for the superstructure. After these contracts were let it was decided to provide two lines of street-car tracks over the bridge, and the necessary changes in floor plan were accordingly made. The contract for this work was let Aug. 22, 1890, to McCauley & Morse, of Pittsburgh, which firm also erected the bridge under contract with the Smith Bridge Co.

Masonry was commenced Sept. 20, 1889, and completed Oct. 19, 1890. Erection commenced May 20, 1890, and the last span was swung Nov. 20, 1890. Much delay was caused by the slow delivery of creosoted lumber, but the bridge was finally completed and opened to the public with appropriate ceremonies on Feb. 18, 1891.

The bridge consists of an iron viaduct 780 ft. in length, forming the approach on the north side, and 6 spans crossing the river channel, of which three are 210 ft. between centers of end pins and three are 320 ft., making the entire length of the bridge 2,370 ft.

The total cost of the bridge that passed through the engineering department was as follows:

Substructure	$96,197.50
Superstructure	130,189 16
Inspection	3,980.75
Engineering and incidentals	8,194.34
Total	$238,561.75

The quantities of material in substructures are as follows:

	Cu. yds.
Masonry, Class B	8,588
" rubble	305
Concrete in foundations	324
Excavation from coffer dams	735
Excavation from dry foundation, earth	1,107
" " " rock	80
Grading in approaches	670
Timber in coffer-dams	99,200 ft. B. M.
Puddling " "	3,150 cu. yds.

The quantities of material in superstructure are as follows, exclusive of spikes and handrailing:

3 spans of 320 ft. each, iron and steel	1,102,351 lbs.
Average weight per ft.	1,148 "
3 spans of 210 ft. each, iron and steel	549,660 "
Average weight per ft.	872 "
Viaduct, 780 ft., iron and steel	309,221 "
Average weight per ft.	396 "
Total iron and steel	1,961 232 "
Entire bridge, yellow pine creosoted	333,222 ft. B. M.
" " " " not creosoted	126,606 " "
" " white oak	106,660 " "
Total timber	566,488 " "

It is interesting to note that the engineer's estimate of iron and steel in the structure was 1,962,697 lbs, a variation from the actual finished weights of 1,465 lbs., or about one-fourteenth of 1%.

The elevations, grades, design of masonry, strain sheets, distribution of material and details of superstructure are fully shown on the accompanying drawings.

FOUNDATIONS.

Low water, or 0 of Government gage, has been taken as datum for all elevations that may be hereafter given. The average stage of water when foundations were put in was 4 ft. above datum.

Pier No. 0.—The excavation for this pier was carried to elevation 90.5, or about 9 ft. below the natural surface of the ground. The foundation is a hard red clay mixed with flint rock. The masonry rests on a bed of concrete 18 in. deep; 105 cu. yds. of earth were excavated, and the grading on slope in front of pier amounted to 220 cu. yds.

Pier No. 1.—Masonry is commenced at an elevation of 15.0, about 4 ft. below the surface of ground, and rests on a thin bed of concrete, used for leveling up. The foundation is solid rock. About 97 cu. yds. of earth and 80 cu. yds. of disintegrated rock were excavated from this foundation. A seam about 4 ft. deep, running diagonally across this foundation, as shown on the plan, was cleaned out and filled with concrete.

Pier No. 2.—The foundation for this pier is solid rock, which was reached at elevation—13.6 ft., or 17.6 ft. below the surface of water and 7.6 ft. below the bed of river. It is the deepest of the foundations. The rock is smooth and level and is free from seams and imperfections of any kind; 320 cu. yds. of cemented sand, gravel and boulders were excavated. Masonry commences at elevation—13.0 and rests on a bed of concrete having a uniform depth of 0.6 ft.

The coffer-dam was 18 ft. high, or 8 ft. above the surface of water, to provide for future rise. A clear space of 4 ft. was allowed all around the foundation, and a clear space of 9 ft. between lines of sheet piling. This space was puddled with clay to an average height of 12 ft., requiring 900 cu. yds. About 450 cu. yds. of puddling were also deposited around the outside of dam. The coffer-dam and breakwater protection contained about 38,000 ft. B. M. of lumber. After the dam was puddled the water rose 30 ft. above its top without other damage than to wash out about half of the puddling. The dam was exposed to a strong current and had one end crushed by a raft, but the break was soon repaired, and work proceeded without serious delays.

Pier No. 3.—The foundation is solid rock, which was reached at an average elevation of 9 3 ft., or 13.3 ft. below the surface of water and 3.5 ft. below bed of river. The rock dips uniformly to the west, 2 ft. in the length of the pier, and is unbroken with the exception of the small open seam shown on plan. The total excavation was 155 cu. yds., consisting of cemented sand, gravel and boulders, interspersed with pockets of pure coarse sand. Masonry com-

mences at elevation of—8.0, and rests on a bed of concrete having a depth of from 0.3 ft. to 2.3 ft. The coffer-dam was built 3 ft. above the surface of water, 5 ft. bet ween sheet pilings,and contained 650 cu. yds. of clay puddling; 300 cu. yds. of puddling was deposited around the outside of the dam. The coffer dam and breakwater protection contained about 32,600 ft. B. M. of lumber.

The pockets of coarse sand and the open seams in the foundation rock gave much trouble, and the pumps, with a capacity of 5,000 galls. per minute, could not keep the water down. After the first course of masonry was laid the seams were closed with concrete in sacks laid across them and covered with large stones.

Pier No. 4.—The foundation is solid rock, very irregular, and with numerous pockets, as shown on plan. The surface of the rock was ragged and honeycombed, and many detached pieces were found. This was all removed, and the pockets, which were filled with pure red clay, were cleaned out and filled with concrete, except when too narrow to excavate; they were then driven full of 4 × 4 in. piles, packed with concrete. This foundation has an elevation of from 5 ft., the highest point of rock, to 15.3 ft., the lowest point of pockets. Masonry was commenced at 5.0, resting on a bed of concrete, filling the intervening space. The depth of water was about 8 ft. About 2 ft. of sand and gravel were excavated to reach the highest point of rock, and below this the material was red clay. About 180 cu. yds. were excavated.

The coffer-dam was 10 ft. high, or 2 ft. above the surface of water. It was 4 ft. wide between the sheet piling, and contained 500 cu. yds. of clay puddling, while 200 cu. yds. were deposited around the outside of dam. The coffer-dam and breakwater contained 24,700 ft. B. M. of lumber. Masonry was commenced Oct. 4, 1889, and resumed some time after the high water of March, 1890, when it was found that at the west end of the dam the puddle was washed out and the dam raised 1 ft., causing a break under the puddle. This gave much trouble; but after three weeks' work the cavity under the puddle was filled, the dam was pumped out, and the masonry was completed without further difficulty.

Pier No. 5.—The foundation is solid rock, somewhat irregular and cut up with numerous pockets, as shown on plan. The elevation of bed rock ranged from 3.7 ft., the highest point, to 8.4 ft., the lowest point of pockets. The pockets, which were found filled with red clay, were cleaned out and filled with concrete. Masonry was commenced at 3.7 ft., all space below this elevation being filled with concrete. The depth of water was about 5.6 ft. From 2 ft. to 3.5 ft. of compact sand and gravel, amounting to about 80.0 cu. yds. were excavated. The coffer-dam extended 2 ft. above surface of water, had a clear width of 3 ft. between walls, and contained 150 cu. yds. of clay puddling. The coffer-dam and breakwater contained 11,900 ft. B. M. of lumber. This dam was pumped dry at the second attempt, and remained dry until foundation was finished.

Pier No. 6.—The excavation for this pier was carried to elevation 15.0, or about 17.0 ft. below the natural surface of the ground. The foundation is firm blue clay. The masonry rests on a bed of concrete 3 ft. deep; 490 cu. yds. of earth were excavated.

Pedestals.—The excavations for the pedestals supporting the iron viaduct were carried 5.0 ft. below the surface of ground. The foundation is blue clay from pier No. 6 to Meadow St., and red clay from Meadow St. to end of structure; 375.0 cu. yds. of earth were excavated.

North Abutment.—Excavation was carried 4.5 ft. below the surface, where the masonry rests on red clay; 40.0 cu. yds. of earth were excavated and the approach required 450 cu. yds. of embankment.

The coffer-dams for piers 2, 3, 4 and 5 were located accurately by aid of the breakwaters, and no trouble was experienced in moving them in any direction. After the frame of dam was in place it was weighted with rock, and sheet piling was commenced at the lower end. Puddling then commenced and continued while sheet piling was being driven.

The solid rock in the foundations was of the same general character, and dipped toward the south about 1 ft. in 100. When the rock was smooth no clay was found, nothing but sand, gravel and bowlders, the latter getting larger as they neared the rock; but when the rock was rough and full of pockets the gravel extended only to the level rock, and all below that was pure red clay.

The attempt was made to dredge the sand and gravel from the coffer-dams with sand pumps. One pump having a capacity of 3,000 galls. per minute and another of 5,000 galls. per minute were tried; they would take out the loose sand and small gravel, but made no impression on the cemented gravel, and this method was abandoned. These pumps were afterwards used to pump out the coffers, but all excavating was done by hand labor.

MASONRY.

Masonry specified as "Class B" was used in all piers from 0 to 6 inclusive, and ranged rubble masonry was used in the north abutment and viaduct pedestals. Class B masonry is the usual first-class masonry, laid in courses of from 12 to 30 ins. in thickness, except that concrete was allowed for backing. The projections beyond the pitched lines for face stones were limited to 4 ins. in the body of the pier and 2 ins. on the pointed ends. The copings of piers and starlings, the string course under copings, and the pedestal blocks on top of the copings are bush-hammered.

Louisville quick-setting cement was used for all work under ordinary water level, and "Howard cement," which is a good cement, but sets more slowly, was used for all work above that level. Limestone of good quality was used throughout the work; 3,300 cu. yds. were quarried at Concord, near Knoxville, Tenn., and the balance came from Beck's quarry and Stone Fort, near Chattanooga.

SUPERSTRUCTURE.

The trusses are placed 22 ft. between centres. The clear width between trusses is not less than 20 ft. 3 in. at any point; and there are two sidewalks, each having a clear width of not less than 6 ft. at any point.

The live loads assumed in the calculation are as follows: For all truss members receiving more than one panel load, 60 lbs. per sq. ft. of roadway and sidewalks, or 1,920 lbs. per lineal foot for 320 ft. spans, and 75 lbs. per sq. ft. of roadway and sidewalks, or 2,400 lbs. per lineal foot for 210 ft. spans. For joist floor beams, long suspenders, sidewalk brackets and iron viaduct, 100 lbs. per sq. ft. of roadway and sidewalk.

The roadway is also proportioned to bear with safety a 15-ton Aveling & Porter steam road roller. The allowed unit stresses are about 25% less than are usually allowed in highway bridges and about the same as are customary in railroad bridges. It is not likely that the bridge will ever be subjected to so great a load as has been provided for; but even were the assumed loads much exceeded, the bridge would still be abundantly safe.

Wind bracing has been provided for a force of about 30 lbs. per sq. ft. of exposed surface of both trusses and floor system, in addition to 150 lbs. per lineal foot for moving load. The heavy compression members, bolsters, and rollers are steel, having a mean tensile strength of 80,000 lbs. per sq. in. The larger eye-bars and truss pins are steel having a mean tensile strength of 72,000 lbs. per sq. in. The rivets in steel members are steel having a mean tensile strength of 58,000 lbs. per sq. in. The longitudinal and transvere struts in viaduct are steel having a mean tensile strength of 60,000 lbs. per sq. in. All other parts of the bridge are wrought-iron, except washers and floor timbers. All material is of the best quality, and was rigidly inspected at steel mills, rolling mills and bridge works.

The engineering staff engaged in the design and construction of the bridge was as follows:

Chief Engineer, EDWIN THACHER; Resident Engineer, J. H. FAIRLEIGH; Assistant Engineer, E. E. BETTS.

The Improved Sewerage of Boston, Mass.

The following facts regarding the work done or in progress on the improved sewerage of Boston, or its intercepting and outfall sewers, are abstracted from the last annual report of City Engineer WILLIAM JACKSON.

The total expenditures for the work to Jan. 1, 1891, had been $5,672,837, and there was then a balance from appropriations of $240,253. The amount expended in 1890 was $253,585.

Section 7, West Side, within the city proper, was completed during the year by day labor, the bids received being considered too high, and the actual cost, $4,292, being $761 less than the lowest bid. This section extends 528 ft. in Commercial St., from Prince to Charter, and is of 15-in. Akron pipe, imbedded in concrete. Its upper end is 60 ft. above low water, and it has a grade of 1 ft. in 400. It intercepts the sewage formerly discharged into the docks at the foot of Hull and Charter Sts.

Work on sections 5 and 6, East Side, was in progress at the time of the report. The combined length of these sections is 3,165 ft. The sewers are of brick, egg-shaped, 42 × 28 ins., with concrete foundations and side walls. The grade is 1 in 1,500, and the elevation at the upper end is 4.3 ft. above low water. For 200 ft. a solid stratum of old log cob-work, 8 ft. thick, was encountered. There were other obstructions, and as work could be carried on only at low tide, progress was difficult and slow.

Sections 1, Brighton, and 7 and 8, South Boston, were finished in 1890. Tongued and grooved sheet-piling were used in the trenches for the Brighton section, owing to quicksand. All sewage formerly emptying along the water front of South Boston is now conveyed to Moon Island.

In 1884 a wooden flume was built between Squantum and Moon Island to serve as a temporary outfall sewer until the earth embankment, constructed for the proposed masonry sewer, should be fully settled. The distance between the points named is 4,020 ft., and during 1890 there were built, under contract with Mr. H. P. NAWN, 2,100 ft. of this sewer, at a cost of about $100,000. The sewer is of brick, horseshoe section, 11 ft. high and 12 ft. wide. For a foundation it has a 4-ft. concrete base. Its sides are reinforced by stone masonry walls and iron rods extend through the concrete foundation and up through the arch to strenthgen the sewer and prevent injury should further settlements occur. As the embankment has been constructed seven years, none but slight settlements, at the most, are expected.

During the year 14,845 ft. of intercepting sewers were built. It was expected at the time of the report that the balance of existing appropriations would complete all work under contract, but that $350,000 more would be required to finish the improved sewerage system as proposed, including sections 7 to 11, inclusive, of the Dorchester intercepting sewer, the outfall sewer from Squantum to Moon Island, the sea wall at Moon Island and the pumping station at the east shaft of the Dorchester Bay tunnel. This would make the total cost of the improved sewerage about $6,200,000.

Legal Decisions of Interest to Engineers.

Requiring Local License for Commercial Traveler.—An order forbidding traveling merchants or peddlars from selling or offering to sell any merchandise without having obtained a license cannot be enforced against one who sells sample merchandise which at the time of the sale is situated and owned in another state. (McLaughlin v. City of South Bend, Supr. Ct. of Ind., 26 N. E. Rep., 185.)

Construction of Railway in Street.—An abutting lot owner cannot recover damages by reason of the location of a railroad, duly authorized by the city council, along one of the regularly laid out streets of a city, unless there has been a practical obstruction of the street in front of his premises and he is virtually deprived of access to his property. The failure of a railroad company to properly ballast its road-bed, where sufficient space is left in the street for ordinary vehicles and teams to pass in front of abutting property, will not authorize a recovery for damages alleged to have been sustained for the destruction of one's right of egress and ingress, where there is no evidence to show that under the terms and conditions upon which the privilege to build such road was conferred by the city authorizing the same, this was necessary. (Wichita & C. Ry. Co. v. Smith, Supr. Ct., Kan., Pac. 52, Rep., 623.)

Notice of Defective Appliances to Yardmaster.—A railway company is bound to furnish its employés reasonably safe locomotives and reasonably safe appliances thereto, and a competent engineer and fireman, though it is not required to furnish the best that can be secured of either machinery or men. A yardmaster having power to hire and discharge men and assign and direct their work is not a fellow-servant of brakemen under his charge, and notice to him of defects in the step of a switching engine and the want of a hand-rail, and of the incompetency of the fireman, is notice to the company, and his promise to remedy these evils is the company's promise. Where it is shown that different employés told the yardmaster of these evils, and said they were going to quit because of them, but were persuaded to remain by his promise that they would all be remedied, the rule that an employé accepts the extraordinary as well as the ordinary risks of his employment when he continues in it, knowing of defects which create unusual dangers, does not apply unless the company has not failed for an unreasonable time to make the repairs. In determining what is a reasonable time for making the repairs and changes required, the jury should consider all the circumstances, such as the opportunity for making repairs and the frequency with which the engine was used and the opportunity for securing proper employés. (Lyttle v. Ch. & W. M. Ry. Co., Sup. Ct. Mich., 47 N. W. Rep., 571.)

The Comparative Merits of Various Systems of Car Lighting.

V.

The great toughness and strength of the carbureter, a detail to which great weight is very properly attached, as indicating that no serious harm is likely to result from the carbureters even in accidents, is shown in the six following engravings:

Fig. 34 shows a new 25-in. diameter carbureter, with the top of the copper casing cut open and the top perforated plate torn free from the wicking and the spiral partition to which it is soldered, to expose its internal arrangement of perforated top and bottom plates, spiral passage and wicking used for

FIG. 34. NEW CARBURETER CUT OPEN TO SHOW WICKING AND INTERIOR CONSTRUCTION.

holding gasoline in saturation, which it will be seen must necessarily constitute a very solid mass, so connected together by the partitions and top and bottom plates as to be likely to hold together, even if the copper casing were violently torn off.

Fig. 35 shows a new 25-in. carbureter after it had first passed through a fierce fire of shavings and yellow pine kindling wood saturated with coal oil, and then been torn open to show its condition. This carbureter was first fully charged with 4 galls. of 88° B. gasoline, and then through a deck air pipe with a mercurial safety valve on the end charged with air pressure at 3 lbs. per sq. in., as in service. It was then mounted on iron supports and the fire started. In a couple of minutes the pressure soon rose above 5 lbs. per sq. in., at which the safety valve blows off, and vaporized gasoline began escaping from the safety valve, which was placed so near the fire that the escaping gas soon took fire and burned like a torch, the mercury being all evaporated. Thereafter from 1 to 3 lbs. pressure was indicated, being the pressure at which sufficient velocity of exit was obtained to let out all the steam generated. Had all not escaped, the pressure would have gradually risen, and with it the velocity of exit. The carbureters are tested to 20 lbs. pressure and it takes 60 lbs. to burst them. The outer mantle became loosened and twisted and little jets of gasoline steam escaped through holes where the solder was melted away and took fire; but, though the heat of the fire was so intense that the 1¼ in. iron pipes used for supporting the carbureter became red hot and were bent by its weight, there were no signs of any injurious pressure within the carbureter, the safety valve and trifling openings around the soldered joints permitting of escape of gas faster than it was generated, by a fire which was certainly very fierce. It is true that it was as certainly not as fierce in its heating effect as would be a car on fire with a carbureter somewhere inside of it. It is possible, if not probable, that in such a fire a carbureter might pop open from pressure, especially if the pipe leading to the safety valve should chance to have closed by a blow, but the test seemed to conclusively demonstrate that it could in no case do this till long after all life in its vicinity had become extinct from other causes, nor would any such explosion be likely to do more than tear it open.

After the fire built had done its worst it was put out, and the carbureter cooled off and cut open to ascertain its interior condition. Fig. 35 shows the result as noted. The interior wicking was slightly burned on the surface, and on the corners quite a little charred, but it was substantially quite uninjured, and the interior was as white as when new.

Fig. 36 gives a view of another carbureter which, after being subjected to a like fire with a like result, was recharged with 3 galls. of gasoline, and placed under a 5,000-lb. steam hammer. It was first given two or three light blows "to see if the seams could be ruptured," the published accounts say, but this is not quite correct. It was done to first get the air out

FIG. 35. NEW CARBURETER CUT OPEN AFTER BEING SUBJECTED TO SEVERE FIRE TEST.

of the carbureter for fear that it would "pop like a paper bag," and in momentary forgetfulness of the bystanders that what it would do under a sudden blow was the very question to be decided. Whether it would have "popped" or not under such a very severe test is uncertain, but it is at least doubtful, since a final blow with the full force of the hammer

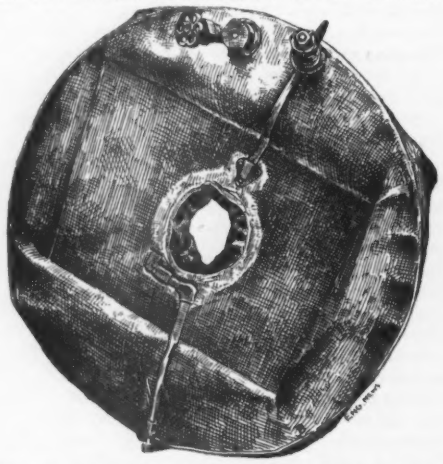


FIG. 36. VIEW OF NEW CARBURETER AFTER HAVING BEEN SUBJECTED TO FIRE TEST AND THEREAFTER RECHARGED AND PLACED UNDER A STEAM HAMMER.

caused no rupture nor considerable escape of gasoline. Fig. 37 shows a bottom view of the same carbureter.

These tests were made in April, 1890, in the presence of the editor of this journal. They were certainly an impressive exhibit of the toughness of the carbureters, and of their ability to withstand hard usage effectively both from fire and violence. The precise conclusions to be drawn from them we shall consider later in discussing the question of safety. In the meantime we record the facts.

Some further tests of the effect of impact on the carbureter were made at Altoona, in June, 1890, of the nature indicated in Figs. 38, 39. They were thus described by the *Railroad Gazette*, whose editor was present at the tests:

It will be remembered that in the "Thaxton's" wreck of July 2, 1889, on the Norfolk & Western, a car fitted with these carbureters was burned. The car was entirely consumed, but the carbureters taken from the wreck showed no sign of explosion. They were distorted, and the soldered joints opened by the heat, but the lights were put out by the shock of the wreck; the fire did not start for an hour and a half later, and there is no evidence that the gasoline had any effect on it in any way.

Nevertheless, it has been suggested that there are two ways in which this system of lighting might cause disaster in case of a wreck. It has been said that a carbureter might be ruptured, and a car flooded with the volatile and inflammable gasoline; or that in case of a fire the rapid vaporization of the gasoline in the carbureter would cause an explosion. It was to show the probability of either of these events that the tests were made.

To show what might happen in case the carbureter was subjected to a heavy blow in a wreck, a new carbureter was placed on a solid backing of timbers, as shown in Fig. 26. The timber backing was, of course, far more substantial than that which the carbureter would have in its normal position on the top of a car, and the effect of a blow delivered upon it must be correspondingly more severe. Back of the timbers was a gas lamp connected with the carbureter. The carbureter was charged with 4 galls. of gasoline, and air was forced in by a hand pump to a pressure of 3 lbs. per sq. in. A drop, weighing 2,079 lbs., was arranged above the carbureter, and shod with timber, the end of which was serrated to represent somewhat the conditions which might be had in a wreck. The bottom of this drop is seen in Fig. 38.

This weight of 2,079 lbs. was dropped from a height of 33 ft. 4 ins., striking square on the carbureter and crushing it, as shown in Fig. 39. [This fall means an impact velocity of 30.6 miles per hour.—ED.] The copper was not ruptured, but a small pipe inside the carbureter which extends into a pocket in the bottom of it, for the purpose of draining off gasoline left in charging, was driven through the metal. The seam where the top plate of the carbureter joins the side was opened for about ⅛ in. in one place. Through these small openings a small amount of gasoline was squeezed out. It was estimated that perhaps half a pint escaped in this way; possibly, it may have been a pint. The iron case was then stripped off the carbureter, it was turned bottom side up, and the weight was again dropped upon it with the same fall, viz., 33 ft. 4 ins. In the first blow the wood had been entirely knocked off the bottom of the drop, so that in this case the carbureter was subjected to a blow from the iron ball alone. The timber backing was entirely demolished. Further openings were made in the soldered seams of the carbureter, but the copper was not ruptured. More gasoline was squeezed out; it was difficult to estimate how much, but it was not considered at all probable that the amount reached a quart after both blows. Of course, the carbureter was smashed flat, so that the volume inside was greatly reduced, and it was physically impossible that there should not have been

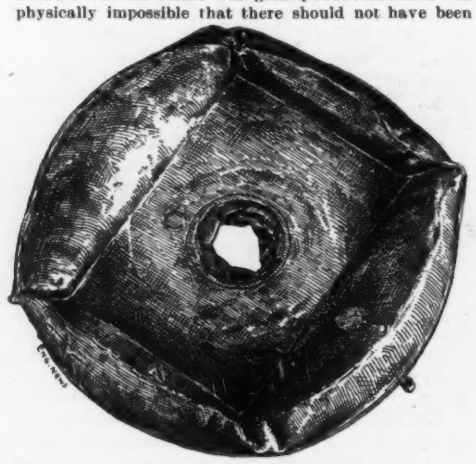


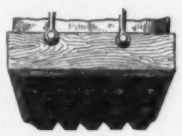
FIG. 37. BOTTOM VIEW.

some escape of gasoline. However, it must be remembered that the carbureter was overcharged with 4 galls. immediately before the tests were made; the service charge is 2 galls., while the first charging of a new carbureter is but 2½ galls. The amount of gasoline which escaped in this case was a good deal less than the excess of the charge over the usual first charge of a new carbureter. After seeing this test it is difficult to conceive circumstances under which any gasoline would be forced out of a carbureter from a blow in a wreck. The gas lamp which was burning back of the carbureter was extinguished instantly at the first blow.

A second fire test followed, similar to that already described.

These tests also were certainly most creditable. We shall consider what appears to us to be the proper conclusions to draw from them later. They so profoundly impressed our contemporary as to draw from it the somewhat sweeping conclusion: "So far as

concerns the traveling public *there seems to be nothing left to be desired* [italics ours] in the matter of safety." It also expressed the conclusion that: "The two elements of danger which have been suggested are *entirely absent* in this system." While not prepared to go so far as our contemporary, which could hardly express more absolute confidence that every element of danger was eliminated if it called in the resources of several other languages besides our feeble English, we may say right here that these tests do show a closer approach to perfect security against certain dangers than we should have believed possible before the tests were made. Such a high degree of safety as to "leave nothing to be desired," cannot rationally be asked for, nor probably ever obtained from any system, but the danger (1) of explosion of a carbureter, and (2) tearing apart so as to scatter pieces of carbureter promiscuously around



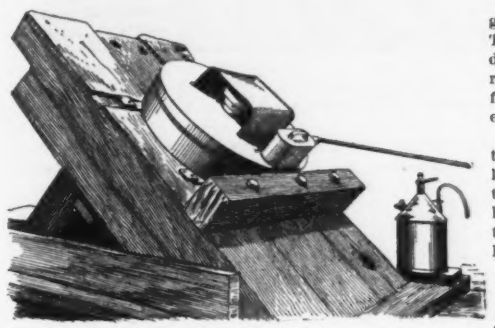


Fig. 38.

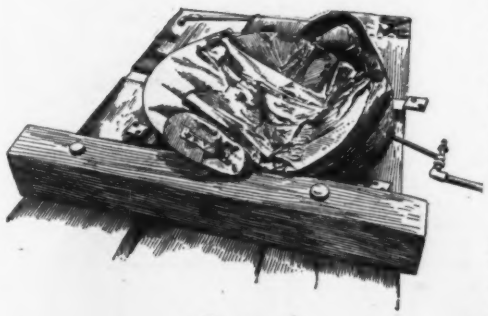


Fig. 39.

the interior of a car, seem remote. But, on the other hand, there are a variety of positions which might occur in a wreck which would try the carbureter more severely than the position of Fig. 38, a pile of 6 or 8 carbureters (it is proposed now to use 8 to 10 on a car for brilliant light) might give very different results from what one carbureter alone did, and the square carbureters now used (as described in our next issue) hold much more gasoline than the style illustrated and tested, while the falling weight, great as it was, inadequately represents both the W and the V^2 of a colliding train. While we endeavor to do these remarkable tests full justice, therefore, by admitting that they showed more resisting capacity than we had previously believed possible, we must not be understood to imply thereby that they indicate even sufficient, much less "entire," safety. They indicate sufficient safety if they show as much or more than can be otherwise obtained at about the same cost; otherwise they do not. Hence a final determination rests upon conditions yet to be determined.

Since the preceding in its present form was in type an incident of some apparent moment in connection with this question has happened, as narrated in the reprint below. Pending the completion of this series of articles, and especially of that portion which relates to the question of the comparative safety of various systems of car lighting, it does not seem fitting for us to discuss the incident in any manner, nor can any one incident be decisive as to the question of absolute or comparative safety. But we deem it proper, and due to our readers, to reproduce without comment the newspaper record of the incident below, as a warning to be a little cautious what they do; and the curious may find by referring to sundry issues of this journal 12 to 15 months ago what was then our opinion as to the possibility of such incidents as that which happened last week. At the present time, pending the completion of these articles, and of all the experiments on which they are based (some of which, of a supplementary nature, are even now in progress), we have no opinions, nor do we allow ourselves to form any, except that *caution* is necessary and that every incident of this nature should be justly and promptly weighed by those responsible for the safety of railway travel, and therefore should be promptly laid before them for their consideration.

The following is verbatim from the Savannah *Morning News* of May 6, minus the usual startling headlines:

Passenger coach No. 298 of train No. 3 of the Central Railroad, which left Savannah Monday night, May 4, at 8:10 o'clock, was totally destroyed by fire at the 20 mile post.

The fire was caused by the vapor arising from escaping gasoline coming into contact with the flame of a lantern. The car was illuminated by a gas made from the Frost dry carbureter system. The carbureter was placed on the roof of the car and filled with wicking. Air passes through from a storage reservoir on the bottom and picks up enough vapor to make a rich illuminating gas.

Through some unknown cause a sufficient amount of this vapor escaped into the lamp holder to extinguish the light, and Porter JOE SMITH undertook to remove [open it] the lamp in order to relight it. As soon as he opened the holder the vapor escaped in large volumes and ran through the coach until it came into contact with the lantern, which stood at one end.

THE CAR FILLED WITH FLAMES.

Immediately there was a loud explosion, and flames shot upward through the car. The passengers, of whom there were quite a number, grabbed up their sachels and beat a hasty retreat through the other door, just in time to escape the flames. The porter stopped long enough to pull the bell rope, and received severe burns on the hands and arms.

Conductor CUBBEDGE, the moment he heard the bell ring, rushed from his cab and saw flames shooting up from the middle of his train. He realized that quick work had to be done, and lost no time in getting to the burning coach and cutting it off from the balance of the train. Had it not been for Conductor CUBBEDGE'S presence of mind the entire train would have been destroyed.

BURNED TO THE TRUCKS.

Nothing could be done to save the coach, and it burned rapidly. As soon as the destruction was complete the trucks were removed from the track and the forward part of the train was coupled to the sleepers, which had been in the rear of No. 298, and the journey to Atlanta was resumed. Although the delay had been of considerable duration, nearly all of the lost time was made up, and the train reached Atlanta yesterday morning only 15 minutes behind time.

The passengers had a narrow escape from being burnt to death, and they were considerably excited over the affair. They all managed to save their effects, however, and all the loss sustained falls upon the railroad company. No. 298 was one of the Central's new coaches, and was worth about $4,800. There was no insurance. Porter SMITH was brought back to the city and given medical attention. His injuries are of a slight character, and he will be all right in about 10 days.

NOT AS SAFE AS WAS THOUGHT.

The gasoline gas system of illuminating has only been recently introduced on the Central, and but three coaches had been fitted up with it. It was thought to be one of the safest systems of car lighting in the world. Before adopting it the authorities of the road subjected it to the severest kind of test to find out whether there was any danger of it causing fire in case of a wreck.

Heavy weights were dropped on the carbureter, but it resisted successfully, and showed that there was no danger of fire from combustion. The Pennsylvania R. R. uses the system exclusively, and the Norfolk & Western and other large roads have also adopted it.

The Central now has but two cars using the light, and the authorities are making a thorough investigation into the causes of Monday night's disaster, to prevent any possible recurrence of a similar character. The Central's new sleepers do not burn any gasoline whatever, and there is not the slightest danger of any such accident occuring to them.

The statement that the Pennsylvania R. R. uses the system "exclusively" is not correct. Only a small percentage of its cars are equipped with it. It is true, however, that the system is in very extensive use on that road, as shown by the table published last week, and it is also true that most, if not all, of the new passenger cars added to its equipment in the last two years have been equipped with it.

Another account of this incident, differing in some details from the above, was published in the Atlanta *Constitution*, May 6, and that the precise nature of this (presumably) significant occurrence may be better understood, we reproduce that account also verbatim:

"Porter, there's gas in this car!" It was on the night passenger which left Savannah Monday evening for Atlanta. The train was about 15 miles this side of Savannah, running on a straight track, and at the rate of 35 miles an hour. It was nine o'clock. The passenger coach just ahead of the handsome new sleeper was crowded with men, women, and children. Suddenly the passengers in all parts of the car commenced sniffing. There was an odor of gas in the car, and as the porter came through it a New York drummer exclaimed as above.

One of the gasoline jets in the forward portion of the car had gone out. The porter climbed upon a stool to light it. He removed the chimney and then discovered that he had no matches. He reached down for his lantern and removed the lamp proper from the glass encasement in order to light the jet. [This is obviously impossible.—ED.] The eyes of every one in the car were naturally upon him. He raised his torch. An explosion followed; the porter dropped, and a sheet of flame spread from one end of the car to the other, over the heads of the passengers. In an instant it seemed that every piece of wood in the car was a living flame. The men jumped for the bell rope, and in the excitement literally tore it to shreds. Men rushed to the car doors, and women screamed as the train sped on, carrying them in a prison of flames.

The train was quickly brought to a halt, but it seemed an eternity to those boxed within the encasement of fire. Before the last passenger got out flames were bursting through the car windows and licking the roof. Many escaped only with their lives, leaving their hand baggage to the flames.

But for the quickness and coolness of the crew the entire train would have been consumed. Conductor BEEBE quickly uncoupled the burning car from the others. The front cars were pulled ahead by the engine and the rear sleeper forced back by the combined strength of the men aboard the train. Then the engine ran ahead to the next station, where another passenger coach and the wrecking crew were wired for. There was a delay of about five hours before the iron remnants of the burned coach could be removed.

Fortunately but one man was injured. He was Conductor CUBBAGE, who was not on duty, but happened to be coming up on the train. In his efforts to aid the passengers and remove the other cars one of his hands was badly burned and his face scorched.

We need hardly say that our columns stand wide open for any accounts or explanations of this incident tending to throw a different light upon it, or to explain how it is consistent with that perfect safety which has been claimed for the system, and which certain presumably competent persons have been so ready to certify to on evidence which to their minds seems to have been absolutely conclusive.

(To be continued.)

The New Shipyard at Newport News, Va.

One of the largest and best equipped shipbuilding establishments in the country is that now approaching completion at Newport News, Va., the property of the Newport News Shipbuilding and Dry Dock Co. The plans of the company are by no means complete, and construction is still in progress on a part of the plant; enough has been done, however, to get the works in running order, and vessels are already being turned out.

A correspondent of ENGINEERING NEWS, Mr. WM. H. WILEY, who has recently visited Newport News, furnishes us with the following details of this plant:

The works cover a tract of 60 acres, which has been leveled off by excavating the face of a bluff, and on it shops, offices and various buildings have been erected, an enormous dry dock has been built, and ways have been constructed capable of launching ships of great size. Two marine railways capable of hauling out a 2,000-ton vessel are nearly ready, and, in short, nothing is lacking which money can purchase or skill in design can suggest. The frontage on the water is 1,825 ft., and the buildings already erected cover 5 acres. The Chesapeake & Ohio Ry. running into the rich coal and iron regions of Virginia and Tennessee, furnishes a means for obtain

ing all needed supplies; and the fine harbor, with its great depth, gives an outlet to the ocean.

This is, certainly, an ideal place for a shipyard. In 1881 a party of capitalists visited this place among whom was the prime mover in this enterprise, Mr. C. P. HUNTINGTON, who at that time predicted 12,000 inhabitants for the locality by 1890. It is stated that 15,000 represent the fulfilment of his prophecy. The Chesapeake & Ohio Ry. has now 18 miles of track in the shipyard.

The principal buildings are as follows: A pattern and joiner shop, 3 stories, brick, 60 × 300 ft.; a machine shop, iron and brick, 100 × 300 ft.; a boiler shop, iron and brick, 100 × 300 ft.; a blacksmith shop, brick, 100 × 300 ft.; a bending shed, iron and brick, 60 × 127 ft.; a ship-fitters' shop, iron and brick, 60 × 320 ft.

The other buildings are: A ship blacksmith shop, frame, 120 × 208 ft.; a pipe-fitters' shop, frame, 50 × 208 ft.; a power house, brick, 40 × 130 ft.; a lumber shed, 2 stories, frame, 40 × 300 ft.; a pump house, brick, 43 × 60 ft.; a paint shop, frame, 40 × 121 ft.; a stable, 2 stories, brick, 40 × 60 ft.; a time-keeper's house, frame, 50 × 40 ft. This last is quite a pretty little building. It is located near the entrance to the grounds, at the lower end.

There are 12 buildings in all, and 9 of them are of brick. All are well built, and are equipped with first-class machinery and tools. There is in addition to these an office building of brick, 3 stories high, 40 × 200 ft. The drawing-rooms are situated in this, and are remarkably light and thoroughly ventilated.

The foundations to the brick buildings rest on piles; a view of one in course of erection is shown in Fig. 1, and from the general appearance of the ground, it is easy to see the difficulties met with by the constructors.

Fig. 3 shows a cross-section and Fig. 4 an inside view of the machine shop, which was designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn. The building is 100 ft. × 300 ft., and is divided into a central portion 50 ft. wide, with two wings, each 25 ft. in width.

The central portion is traversed by a hydraulic traveling crane of 45 tons capacity. The rails on which this crane moves are placed 48 ft. 5 ins. from the top of the floor, so that large machinery can be moved over other large machinery standing on the floor. Hydraulic jib cranes of 5 tons capacity are also placed in the central portion. The wing portion of the building is two stories high, the lower story being 18 ft. 1 in. in height, and the other floors 14 ft. in height. The interior of the building is lighted with large windows in the outside walls of both galleries and in the end walls as well. Also on the sides of the central portion, above the wing trusses, there are large windows which admit light into the interior of the central portion of the building.

Extending the whole length of the building is a ventilator with shutters on each side, opening and closing by cords from the floor. All the frame work of the building is made of iron, but the outside walls are of brick placed between iron posts and secured by iron braces connected with the posts. The roof is made entirely of iron, that is iron trusses with iron purlins and corrugated iron covering.

There are four piers and an outfitting basin of the following dimensions:

No. 1.....	60 x 900 ft.	No. 4.....	60 x 550 ft.
No. 2.....	60 x 550 ft.	Outfitting basin..	900 x 500 ft.
No. 3.....	80 x 350 ft.		

On the shipways at the time of this visit there were four vessels partly completed, and the keels for two others had just been laid. There are eight ship ways in all, of which two are 400 ft. long, two are 450 ft. long, and the remaining four are 500 ft. long.

On the day preceding this visit the keels of two iron ships over 400 ft. long were laid by 4 men in 4 hours on each keel. There is a large traveling crane on a trestle work between the ways, with an arm extending over each way, and this so facilitates the handling of material as to make rapid work possible. In fact, one examining this yard is thoroughly impressed throughout with the careful study of the problem how to do the mostwork with the least labor and expense. It is the accomplishment of just such results as these which shows the skill of the engineer and marks an era in the history of any construction to which he has given his thought. Labor-saving devices are regarded by some as being injurious to labor, the fact being quite overlooked that

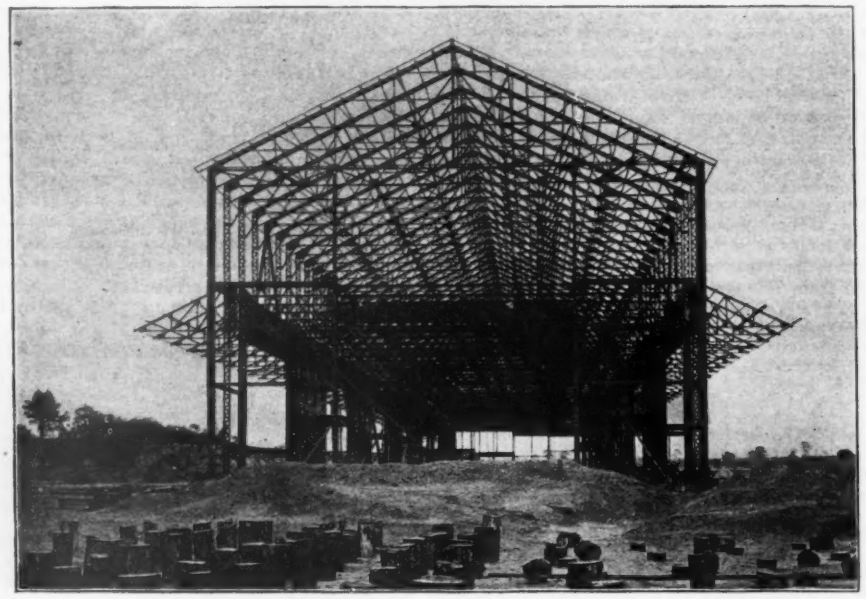


FIG. 1. IRON FRAMEWORK AND PILE FOUNDATION FOR BUILDINGS. NEWPORT NEWS SHIPYARD.

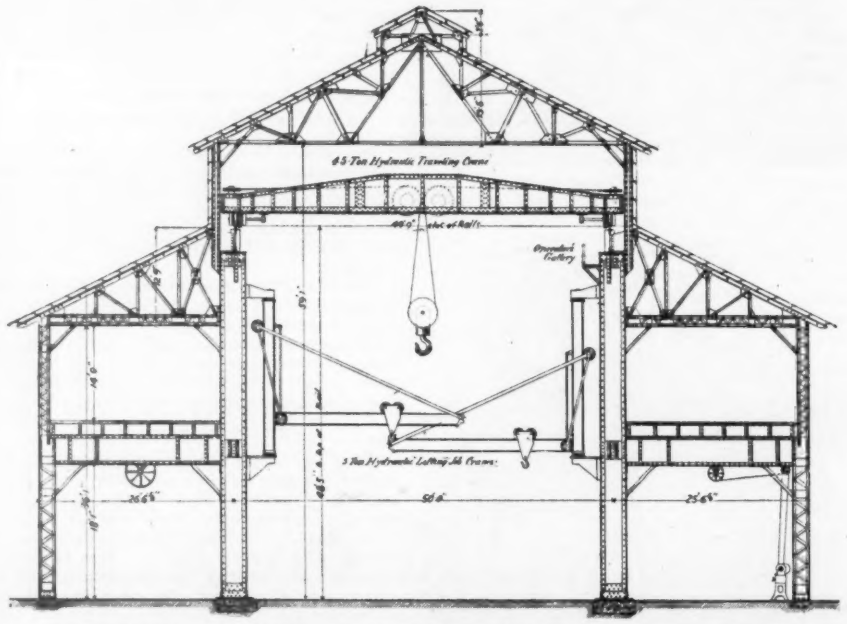


FIG. 2. CROSS-SECTION OF MACHINE SHOP, NEWPORT NEWS SHIPBUILDING & DRY DOCK CO.

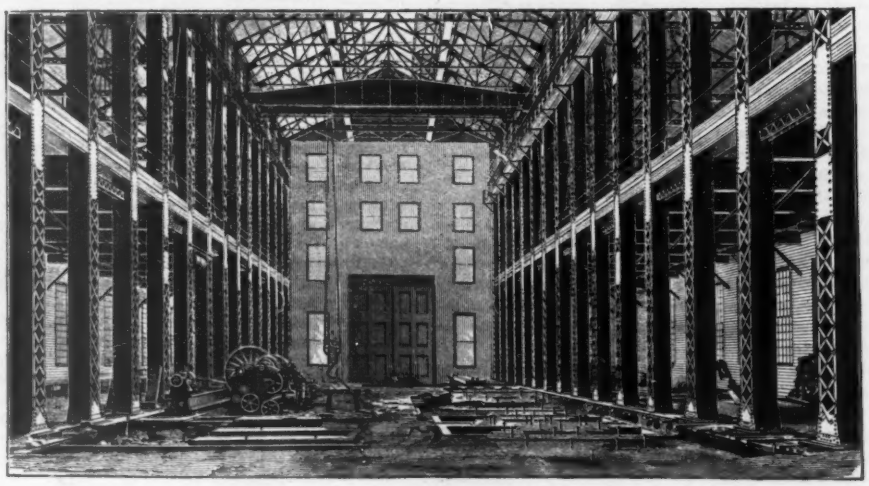


FIG. 3. INTERIOR OF MACHINE SHOP.

the moment production is cheapened, the use of the article is stimulated.

The next thing to launching a ship is the means to repair her, and so the dry dock shown in Fig. 4 claims attention. This was built by the celebrated constructors, J. E. Simpson & Co., and the dimensions are as follows:

Length on top	600 ft.
Width on top	130 "
Width on bottom	50 "
Width at entrance	93 "
Draft of water over sill	25 "
Time required for pumping water out of dock,	1 h. 30 min.

[This dock was described in connection with the dock at St. Johns, Newfoundland, which is of almost identical construction, in ENGINEERING NEWS, Oct. 12, 1889.—ED.]

The photograph shows a monitor in the dock, and gives a fair idea of its dimensions. It is stated that the foundations were so carefully laid that the settling since construction may be considered as nothing, it has been so trifling.

It is the intention of the shipbuilding company to add to the land already inclosed by taking in a strip just above the works. The improvement company has built six blocks of houses for employees just outside the ship yard. They are of brick, conveniently arranged, and very attractive in appearance, having neat yards in front and at the back.

Altogether, the whole arrangements of the plant and its surroundings show the intention to build better ships and at less cost than heretofore. There is an air of permanency about everything, and the visitor feels that the company has come to stay.

Of course, such a great enterprise as this requires a splendid force of engineers of the best type, and, above all, a consulting engineer of standing. The former are to be found acting in their various capacities; while the latter appears in the person of Mr. HORACE SEE, so long and so favorably known in his connection with Wm. Cramp & Sons, of Philadelphia, many of whose great triumphs in naval architecture were largely due to his skill. But Philadelphia, good and quiet as it is known to be, is only the place to begin a man's education; the Metropolis is the place to develop; and Mr. SEE, after being "Cramped" for so many years, desired to grow, or, in other words, to "See." So he moved to New York, and has, since his advent here, been rushed with work.

It now remains to chronicle the most recent work of this engineer and of the shipyard as well, which is the quadruple expansion engine of the iron tugboat Dorothy, shown in Fig. 5. This boat, built by the Newport News Shipbuilding Co. for the New York & Northern R. R. Co., was designed by Mr. HORACE SEE. The idea which has been successfully carried out, is to have a boat easily handled, with an engine of great power and comparatively small coal consumption, and yet occupying the minimum amount of space. The engine and boiler take up less fore and aft space than those of the ordinary two-crank compound engines, or than the three-crank triple expansion engine, while the coal consumption is said to be 30% less than in boats with compound engines of the same power.

The boat demonstrated her sea going qualities when coming from Newport News to New York City. Although there was a heavy swell she shipped no water, nor did the new machinery develop a single hot bearing. From her trial trip the following results were obtained:

Steam at engine	180 lbs.
1st red	70 "
2d "	28 "
3d red	0 "
Vacuum	27 in.
Revs. per min.	110

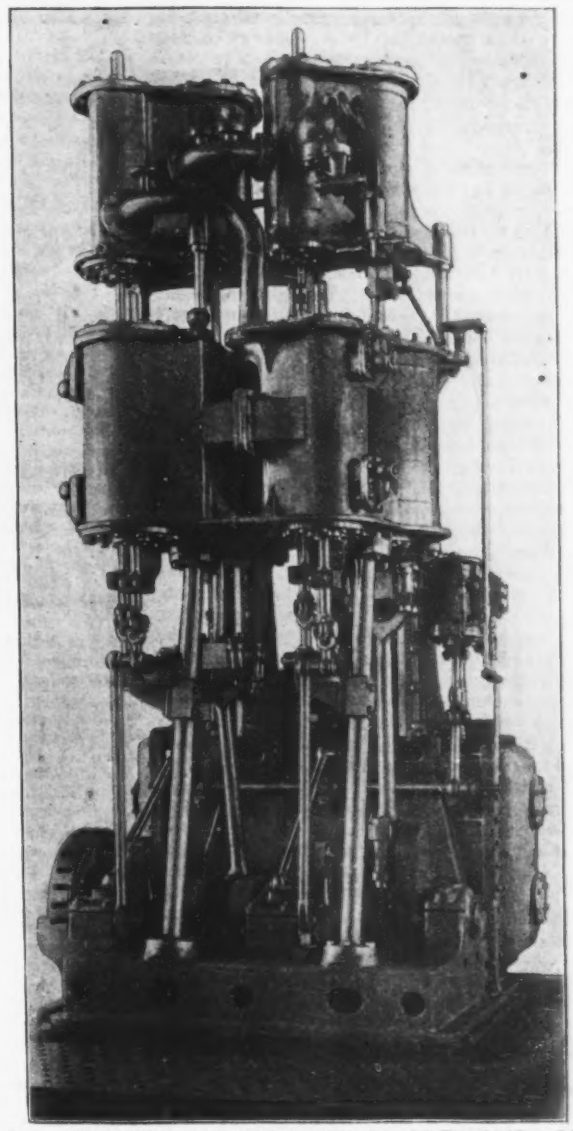


FIG. 5. QUADRUPLE EXPANSION ENGINES OF TUGBOAT "DOROTHY," FOR NEW YORK & NORTHERN R. R.; NEWPORT NEWS SHIPBUILDING & DRY DOCK CO., BUILDERS.

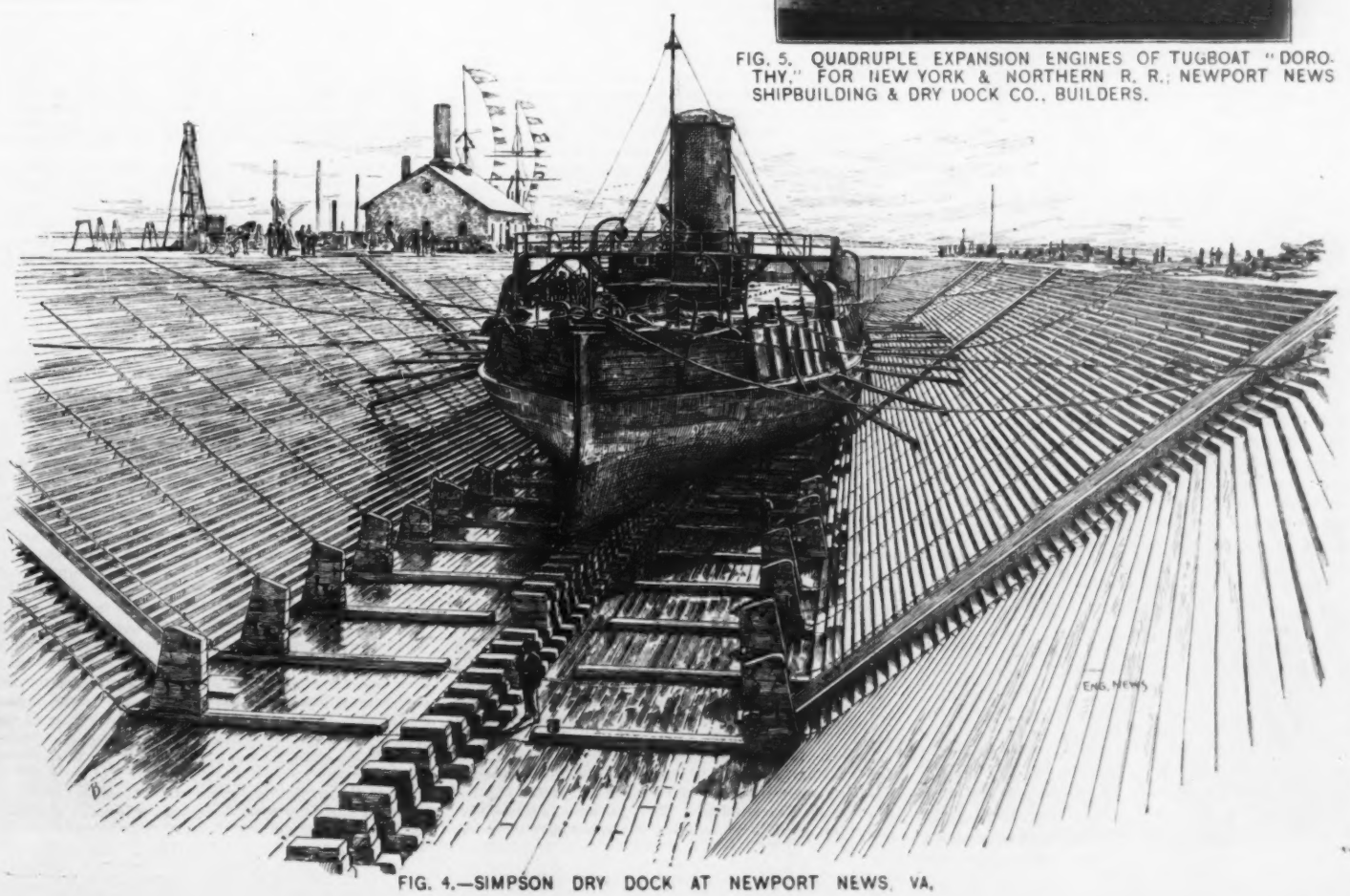


FIG. 4.—SIMPSON DRY DOCK AT NEWPORT NEWS, VA.

This type of engine is particularly adapted for yachts, where fore and aft space is of so much value for the necessary passenger accommodations, while coal endurance is at the same time an important factor. A frequent stoppage to coal up is not only a great nuisance, but also an item of additional expense.

The dimensions of the "Dorothy" are: Length over all, 90 ft.; beam, molded, 19 ft.; depth, 10 ft. 9 ins. The deck-house is of iron, fitted with round side lights throughout. The pilot-house is of wood placed on top of the iron house, with captain's room in the after end. The engineer's room is aft of the engine on the starboard side. The galley and mess-room are forward of the boiler, which is sufficiently low to allow the floor of galley to be lower than on the ordinary tug boat. A cabin forward contains 2 staterooms and 8 open berths. An ice-house and fresh-water tanks are included in the outfit. The boat is steered by steam, the engine being located below in the main engine room in a convenient position for proper care and attention.

The main engine is of the vertical, surface condensing, quadruple expansion type, built with two cranks working at right angles to one another, two pistons being connected tandem to each. The cylinder diameters are 9¾ ins., 13⅛ ins., 18¾ ins. and 26 ins., with 22 ins. stroke of piston. Steam of 180 lbs. pressure is employed. The lower cylinders are bolted together and supported on one side by two columns, which are cast on the condenser, and on the other by two wrought-iron columns fastened to the bed plate. The former columns also form the guides, which are of the slipper-slide variety, with water circulation through the go-ahead face. The front of the engine is open for examination and feeling of journals. The upper cylinders are bolted together, each one being supported on three columns secured to lower cylinders. All of the cylinders are fitted with piston side valves operated by the See-Marshall valve gear, reversed by steam gear from the upper platform. All of the main steam piston and valve rods are fitted with the See metallic packing. The condenser is fitted with brass tubes and sheets. An independent centrifugal circulating pump supplies the condensing water. The air pump is driven from the after crosshead, as are also the feed and bilge pumps. There are also two independent, vertical pumps, arranged either for feed, fire or bilge service. The circulating pump is also provided with a bilge suction for pumping out the boat. An extractor is provided to remove grease, air, etc., from the feed water. The propeller shaft is covered with brass at the water end, which revolves on a lignum vitæ bearing. The propeller is a solid, true screw of iron, 7 ft. in diameter.

The boiler is of steel, of the cylindrical return-tubular type, fitted with two corrugated furnaces leading into one common combustion chamber. It is 9½ ft. in diameter by 10½ ft. long. The stack has been hinged to enable it to be let down if necessary when passing under some of the Harlem river bridges.

A large duplex pump is arranged on the deck, forward of the engine, with suction and discharge connections to side of house, so as to enable it to be used either for wrecking or fire purposes, suction and fire hose being on board and arranged to meet either emergency. A hand pump is also on top of house connected with the sea and bilge, and available for either fire or pumping out boat. The cylinders, boiler and steam pipes are all covered with non-conducting material. An anchor with chain and hand windlass are fitted forward on the double bitts. Bitts are conveniently arranged at both ends and sides of boat. A metallic life-boat with davits is secured on top of engine skylight. Life preservers, fire buckets, etc., are placed at convenient points.

The body of the boat is painted black, and the houses a buff color, similar to that on the cars of the railway company.

The work which this new shipbuilding company is doing ought to be of interest to every patriotic American, since it promises to do much for the revival of the work of shipbuilding, in which the United States once ranked so high. The next step after building our own ships will be to sail our ships under our own flag. It is rumored, indeed, that the company intends to take advantage of the new shipping laws, and will soon build two ocean steamers to sail under the American flag.

The World's Use of Artesian Wells.

The extent and importance of the use of artesian wells in this country and elsewhere is not, or has not until recently, been generally recognized. Perhaps no single publication has done so much to call attention to this subject as the Government report on artesian wells, and their relation to irrigation in the West, prepared under the direction of Mr. R. J. HINTON, of Washington. This report was reviewed in our issue of Feb. 14, and made the basis of four articles on Artesian Well Practice in the Western United States, which appeared in our issues of Feb. 21, March 14 and 28, and April 4. In Mr. HINTON'S introduction to the above-named report he gives an interesting review of the World's Use of Artesian Wells, most of which we give in full, as follows:

The modern methods of boring for artesian water did not come into existence until the beginning of the present century. The French Society for the Encouragement of Agriculture, in 1818, was the first mover in that direction, and since then the improvement has been most rapid. The Chinese still pursue the ancient method of percussion in the boring of artesian wells, and they have followed it for more than 3,000 years. The utilization of underground water is a leading fact in the history of oriental regions and its importance can be realized by an illustration from one country alone. The plateau or high table-land region, which forms the greater portion of the peninsula of Arabia is without a single perennial stream or body of surface water. A population of 12,000,000 resides therein; large quantities of wheat, durra, barley, millet, beans and tropical fruits are grown on this high, apparently dry, sterile plateau. Ninety per cent. of the water supply which produces the present fertility is drawn from below the surface by means of old bored wells, and deep wells or tanks that are dug into the surface of the soil, some of them to a great depth, partly cased with timber or clay, into which the water pours by seepage or percolation from the surrounding earth, and is then drawn to the surface by the old-fashioned wheel and bucket the power of which is furnished by camels or asses. The Mohammedan population of this peninsula is but little known to the traveler. PALGRAVE and others, who have visited them, speak of the comparative comfort and prosperity they enjoy. They are among the most intelligent and moral of their faith. That a much more abundant life was once seen than now exists, is evidenced by the remains of great cities which have been found. In the southern portian of the peninsula, and approaching the Indian Ocean, springs abound, the water of which is drawn off into tanks, or wells, as they are called. They are thus kept from loss by evaporation, to be distributed by means of well-sweeps to the thirsty soil. In a more northerly portion, the only supply comes from cisterns in which the winter torrents are stored. The striking fact in all of Central Arabia, however, is that of underground supply. Throughout the eastern part of Oman, on the Persian Gulf, and especially in the villages of Kaseen, as an illustration of the character of these supplies, it may be stated that there are 40 wells, the flow from which maintains a population of between 25,000 and 30,000 persons. The depth of these underground supplies ranges from 15 to 200 ft.

EAST INDIAN IRRIGATION BY WELLS.

In British India the system of irrigation by wells is carried on most extensively. Sir JAMES STRACHEY, in his great work on the Finances of India, some years since, placed the area of cultivated land at 200,000,000 acres, of which 28,000,000 acres were cultivated by irrigation. Of this total, about 12,000,000 acres were served by water drawn from wells, and generally by man-power, it being found that the use of the mot or bullock-well is too costly for that country of cheap human labor. The general verdict among engineers and practical administrative officials is that the land irrigated by well-water is more economically served than that irrigated by water from canals. Canal water is, however, more fertilizing, having been exposed to the sun. The waste of water in canal use has been found to be so great in many portions of India that the engineers have commenced the work of lowering the canals, so as to compel the lift and distribution of water by mechanical means. This results in greater economy in its use. The 12,000,000 acres spoken of as supplied by well-water include, in the main, only the provinces directly under British administration. In the native states tributary to Great Britain, the number of wells and village tanks, which are usually large excavations designed to secure the seepage and underflow water, and of the drainage of elevated ground in the neighborhood, is much greater. It has been estimated that the area covered in the Indian peninsula by well irrigation is not less than 20,000,000 acres. From accessible statistics of 11 districts, including Madras and the Punjab, allowing 10 acres for each well, 392,593 are reported, serving 3,925,930 acres. The British Government, since the famine period, has given great encouragement and attention to the system of village wells and community tanks, allowing bounties for their protection, and providing careful regulations for their maintenance. They have found it cheaper and wiser to assist in securing a permanent supply of water so as to prevent famine, than to feed the people after the famine comes.

ASIATIC USE OF UNDERGROUND SUPPLIES.

In Sind, Beloochistan, Cashmere, Afghanistan, Persia, (especially the plateau of the Iran region), Chinese Turkestan, and in Russian Turkestan, underground waters and their restoration to the surface by gravity or lifting have always played a most important part. A vast system of underground conduits exists throughout the regions named, especially in Persia, that are designed to carry the drainage waters of the foot-hills regions for long distances until they debouche upon the less elevated plains below. So enormous is this supply, that vast populations have, for many centuries past, been supported from the fields that were quickened by the application of such waters. The proofs of their enormous extent are found throughout the whole of Central Asia, the great plateau and hill country which belongs to the Himalayan system. It has been suggested by observers traveling through Persia and elsewhere that these karnaks, or underground conduits, have the effect of desiccating the soil above the area of their influence as they pass from foot-hills to the plains. This, if true, is probably due to the clumsy character of the system, and not at all to the endeavor to secure the utilization of the underground drainage waters. As an illustration of the nature of the subterranean water supply, the evidence of Civil Engineer J. W. BARNS, a former member of the Bombay public works department, who was stationed some years since in Beloochistan and the hill district of western Sind, may be taken. He says:

I had long entertained the idea that subterranean water existed in certain localities in the hills capable of overflowing through artesian borings, if they were made, and in 1885-6, I determined, after a critical examination, to give this mode of obtaining water a trial.

Mr. BARNS' labors were commenced about 8 miles northeast of Kurrachee, and in the course of a few weeks he was able to pierce the first water-bearing stratum, "when the water rushed up and overflowed the surface, continuing without intermission to flow to this day. The temperature of the water is 83° F.' Though slightly brackish, it is useful for irrigation. Mr. BARNS regards the large springs which abound in the district wherein he worked as proceeding from the same source as the artesian supply. At a lower depth he expected a larger and purer yield, and suggests a continuance of boring to the tertiary strata. This is the same which our geologists reported as underlying western Nebraska and Kansas. The description of the region in which Mr. BARNS worked, climatic considerations aside, bears a striking parallel to the southeastern porton of New Mexico, in which there is a great spring section continuing south and east into the lower part of the Panhandle and other section of Texas. Mr. BARNS says in relation to the general subject of subterranean supply:

In dealing with this question, we start with the absolute certainty that wherever water is found inland, whether in the shape of springs or rivulets, it has but one origin, namely, the supply from the clouds in the form of rain and snow. We are in the habit, because some large portions of those zones just beyond the tropics contain vast deserts, and have no rivers draining toward the ocean, of assuming that there is literally no rainfall. But it is a mistake. Even the Sind, which is spoken of as being destitute of rain, has gauged a rainfall of 40 ins. in some parts in three months, and averages, I believe, 4 ins. per annum.

The value of local irrigation is shown by the Indian revenue reports. The land irrigated by wells in the Madras Presidency, being about 2,000,000 acres in extent, yields a revenue of $7,500,000, against the $10,000,000 derived from 25,000,000 acres of non-irrigated farm land. In one case the land revenue or rent is $6.75 per acre, against $2.50 per acre in the other. The intrinsic or market value of crops from irrigated lands will average $8.50 per acre as against $2.50 in the non irrigated. The latter depends entirely upon the local rainfall.

It is a fair estimate that there are in the world to day at least 200,000,000 persons depending solely for their food upon areas irrigated by water drawn in the most primitive manner from underground sources in the form of wells, springs or drainage conduits, such as have been referred to as existing in central Asia and Persia. An examination of the records, habits and customs of the communities so supplied will show an elaborate system of care and maintenance. The coutnries in which this system has been most widely practiced have in past centuries been highly civilized and have borne a large share in the ancient history of the world. They have not failed to maintain their position by reason of the failure of the water supply, but because of the ravages of war, the extent and proofs whereof are seen on all sides, which have devastated and destroyed their fields and works. In the past history of this vast portion of the world the people of whole states have been swept out of existence. The constant and unchanging tendency of climatic aridity has conquered the ameliorations produced by human industry, filled up the conduits, choked the wells, destroyed the surface works, and from want of the cultivation theretofore existing produced and intensified the vast desolation which now exists over such large areas. The re-establishment of the irrigating works and the conservation of the water supplies required therefor, will quite certainly restore enormous portions of these great areas to the use

of man. If such things can be done under the tropical sun they will certainly be achieved in our more favorable climatic conditions and through the quickening activity of the mechanical and inventive genius of our people.

AUSTRALIAN INVESTIGATIONS AND EXPENDITURES.

The British colonies of New South Wales, Victoria, South Australia and Queensland are actively interested in the problems of artesian or other subterranean waters. Considerable sums have already been expended directly by these colonial governments in boring for well water and in the construction of the tanks to store the waters of percolation. Bounties are given in aid of private enterprise, and "trust" organizations have been framed to enable the "shire" or county authorities to issue bonds, construct works, bore wells, store water, and provide for their conservation and distribution. Besides the direct encouragements, these Australian colonies annually expend large sums of money in investigation and in the publication of the results of the same. The irrigation reports of New South Wales and Victoria are among the best and most instructive issued in the world. It is said by one of the scientists employed by the colony of New South Wales that 1 in. of rain over the whole colony at the right time is worth a million of money; that is, $5,000 000 of our money of account. The average annual rain-fall for that colony is given for a period of fifteen years at 28.08 ins. The evaporation in 1888, as gauged at nine stations, averaged 47.72 ins., the largest annual loss known since observations have been taken. Other and interesting investigations relate to loss by drainage, and the conclusions reached are striking. Lake George is an important body of interior water. The watershed area is 12 times that of the lake proper. The gauges in use show that on the occasion of a great rains-torm the lake waters arose exactly 11¼ ins. Of this 8 ins. were directly due to the rainfall, the balance being drainage. If the fall of the whole area had been conserved, the lake would have risen 96 ins. As it was the observations show an immediate loss by drainage of 84½ in. This proves a natural conservation into the lake through percolation of but 3½ ins. of the total precipitation. In the Darling River basin the drainage conservation during the wettest year of observations amounts to but 2.33% of the total rain-fall on its surface. These facts justify a belief in the enormous extent of existing and continuous underground supplies of waters to be made available for arable and pastoral irrigation. Several thousand flowing and rising wells are mentioned, and their use is given in the colonial reports.

RECLAMATION OF THE ALGERIAN SAHARA BY WELLS.

But the most remarkable example of reclamation by means of artesian well water is found in the desert provinces or departments of Algeria under the French rule. The area, officially given, of French Algeria is 184,465 square miles. The outlying portion is put at 135,000 square miles. In this total of over 329,415 square miles one-half belongs to the Sahara or desert. The European population in 1887 was about 250,000; the natives and naturalized were 3,328,549, making a total of 3,578,549. Cultivation by the means of flowing well-waters has been seduously fostered by the French Colonial Government for both political and economic reasons. Such wells as a means of reclamation began systematically to be bored in 1857, the French Engineer, M. Jus, having demonstrated in 1856 that the desert was endowed with large supplies of underground water. The total number of wells that have been bored since that date in the departments of Algiers, Oran and Constantine is stated at 13,135. These wells range from 75 to 400 ft. in depth, and the low pressure common to the majority of them forces the water over the small-bored casings to a distance of about 2 ft. above the ground. The waters are then collected in small ditches, which convey them to the vineyards, date trees and fields of durra, millet, wheat, etc., which comprise the chief products. In all about 12,000,000 acres have been reclaimed in this way. The government bores are at least $\frac{1}{10}$ of the whole number.

As an illustration of the reclamation brought about by this well irrigation, the following figures from a report made in 1885 will be of value, but they relate solely to the cultivation of the grape for wine-making purposes. In the province of Algeria there are 60,322 acres; in Constantine, 25,021 acres; in Oran, 26,114. Under this species of cultivation Algeria is becoming a great wine-growing country. It sent to France during 11 months of 1886, 10,513,966 galls. of wine; and of cider in the same year, 219,277,124 galls. were made. The date palm is the largest product of the desert oases proper. The total area under colonization or settled occupation in 1887 is given at 49,400,000 acres; under cultivation by irrigation in wheat, barley, oats, vines, olives, dates, tobacco, etc., at 17,011,133. The forest plantations cover 5,000,000 acres.

Mr. HINTON next quotes from an article by Mr. G. ROLLAND in the *Revue Scientifique* for June, 1886, regarding the province or department of L'Oued Rir. Mr. ROLLAND divides oases into those formed by rivers, common wells, springs and artesian wells, and says that sometimes all classes are combined. Common wells are quite numerous, in the Algerian Sahara, especially in the central part, but the most prosperous sections are those having artesian waters. In some parts of the Sahara and the province of Constantine water is found from 10 to 20 ft. from the surface which when tapped rises rapidly. The area in which it is found is new and sometimes below sea level. Thousands of acres have been reclaimed by removing the sand to some depth, the embankment forming a barrier against the shifting sands of the desert, and the roots of vegetation reaching into the wet earth. Date palms are planted to afford shade for grapes.

The artesian wells have a small but steady and permanent flow, and their water is distributed in channels. The supply of water in some sections is so large that drainage is necessary.

Mr. ROLLAND states that in the Sahara regions of Algeria and Tunis there are immense artesian basins, with waters usually soft and palatable, having temperatures as high as 70°. North and west of Constantine there are large numbers of springs. The combined discharge of the wells in L'Oued Rir is given as 34,340 million galls. per year, or 213,714 galls. per minute.

From 1863 to 1872, inclusive, 112,139 acre-feet (325,829 galls. per acre, or water 1 ft. in depth over the whole surface) of water were utilized, and 87,636 acre-feet were wasted at the village of Saint-Denis du Sig, near the River Maherru, southwest from Oran. When we consider that storage is necessary to save so much water, and compare the portions saved and wasted with practice in this country, it is seen that good results are obtained in this instance.

The first well was sunk in June, 1856, and yielded, when completed, 1,040 galls. per minute. The French government had, in 1885, 114 wells which it had bored in the province of L'Oued Rir, and there were 492 other wells in the same region. It is said that in 30 years the flow of the government wells increased rather than decreased. In this province these wells have reclaimed 43 oases, which have about 520,000 date palms in full bearing, 100,000 other bearing fruit trees, and 140,000 date palms of 7 years' growth, 8 years being required for full bearing. The annual value of the production of these trees is said to exceed $500,000.

At the close of the extract from Mr. ROLLANDS's article it is stated that with the aid of artesian wells the French government has extended colonization farther and farther south, taking areas formerly regarded as purely desert in character.

The number and cost of flowing and rising wells in Algiers in 1887 is given as follows:

Provinces.	Artesian and chain-pump wells.	Cost of construction.
Algeria	6,128	$16,280,861
Oran	4,384	15,062,409
Constantine	2,623	13,773,210
Totals	13,135	$45,116,480

Mr. HINTON comments upon the Algerian wells and underground supplies in general as follows:

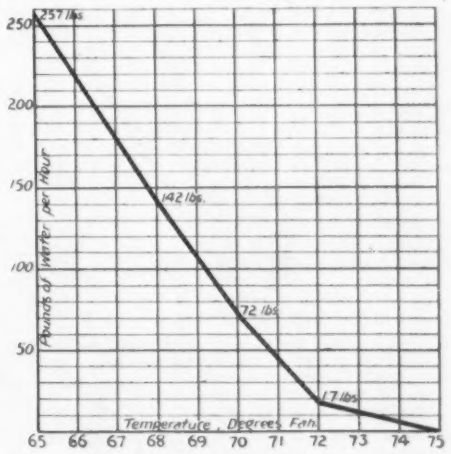
The explanation of the Algerian supplies is very simple. About the desert rise percipitous mountain ranges, towering to a great altitude. The drainage of these mountains, now denuded of timber, comes down with great torrential force, disappearing in the sandy regions below. Where the water collects in basins at the foot of the mountains it soon evaporates under the influence of the summer heat. Disappearing below the sand, these waters give birth to subterranean sheets of water, which, according to the place from which they flow, and the hydrostatic pressure to which they are subjected, have more or less force on being tapped and rising to the surface. The utilization of the Algerian underflow offers a remarkable illustration of the great importance of such waters in their economic use. It would be to a majority of hydraulic engineers and geologists a most unlikely place in which to find such a supply. The existence thereof points to the possibility, indeed the strong probability, of our also finding abundant sub-waters in such regions within our own territory, as the Colorado, the Mojave and the Antelope deserts in California, as well as other desert basins elsewhere.

There are other proofs to be given of the existence in enormous volume and body of the waters of drainage, seepage, and percolation throughout the known world. There is abundant proof also of their use and value in agriculture and horticulture, for power and domestic purposes. Spain, for example, has within the present generation developed a large artesian supply, using the same for farm cultivation, thereby in a more improved form returning to the practices of the Moors. In Italy a great area is influenced and aided by artesian waters. So also in Belgium, France, and Great Britain. Nowhere, indeed, have these subterranean waters, in some form or another, been a failure. Their development, then, is a matter of great importance. When successful they will bring the life-giving fluid to the earth's surface and quicken it into fertility. They will do this if the conditions are fully made clear to the common understanding, under circumstances sure to render co-operation easy and results somewhat uncostly.

Tests of the Consolidated Car Heating Co.'s Automatic Temperature Regulator.

The new temperature regulator introduced by this company during the past season was described in our issue of Sept. 20, 1890. It consists of a double, metallic diaphragm, in which is hermetically sealed a small quantity of volatile liquid, whose boiling point is about 68°. When the temperature rises above this point, this liquid exerts a pressure on the sides of the diaphragm and forces them outward. The pressure thus exerted acts through a cam and lever upon the steam inlet valve, and as the temperature rises the valve is closed. Tests of this regulator upon the Belt line trains of the Delaware & Hudson Canal Co. were made during the past winter, and its working in regular service was found to be practically perfect.

Every regulator before sending out is carefully tested by the company to determine the amount of steam it will permit to pass when subjected to any given temperature. The accompanying diagram



A Sample Test of the Consolidated Car Heating Co.'s Temperature Regulator.

shows a sample test sheet of an indicator for the Chicago, Rock Island & Pacific Ry. recently made at the Consolidated Company's works at Albany.

The steam pressure during the test is kept at 12½ lbs. and the temperature regulator is subjected to varying temperatures to determine the amount of steam which will be permitted to pass with the various openings of the valve which the regulator makes at these temperatures. In the test whose results are shown by the diagram, it will be seen that the first movement of the valve took place when the regulator was subjected to a temperature of 65°. When 68° was reached, the valve was closed to a point where only 142 lbs. per hour could pass. As the amount of steam required per hour to heat an ordinary passenger car is seldom more than 100 lbs., and is usually not more than 40 to 80 lbs., it will be seen that practically the regulator does not interfere with the flow of steam until the temperature exceeds 69°. From this point on, however, the valve is closed enough to rapidly throttle the steam, and when 72° is reached only 17 lbs. per hour can pass. At 75° the valve is entirely closed.

The great defect of many of the electric and other temperature regulators which have heretofore been put on the market has been that they did not keep the temperature steady. The steam valve was not closed at all until the fixed temperature of, say 70° was reached. But at that time the pipes were full of steam and the car continued to heat up considerably beyond the temperature which it was desired to maintain. In cooling down the reverse effect obtained, as the steam valve would not open at all until the temperature fell more or less below the standard.

The Consolidated Car Heating Co. is to be congratulated on having perfected a regulator without these objections, and capable of the accurate and elastic working which the diagram shows.

The Electrical Transmission and Conversion of Energy for Mining Operations.*

Until quite recently all practical methods of transmitting and converting energy involved the actual transfer of matter over the distance in question; and this matter necessarily possessed such qualities as weight, bulk, temperature, inertia and other qualities common to all matter. It is, therefore, not surprising that all engineers, and particularly mining engineers, are watching with the keenest interest the development of methods for transmitting and converting energy by means of electricity; for in the electrical transmission of power the many restrictions due to the inflexible characteristics of matter may be entirely disregarded and the possibilities of mining engineering are correspondingly increased.

The transmission and conversion of energy by water, steam, cables, compressed air, etc., we are all familiar with; and we know to our sorrow the limited distance, the low efficiency, or the tremendous first cost which has hampered our engineering work at every turn. With the utilization of electricity for the transmission and conversion of energy we are enabled to operate at practically unlimited distances, with extremely high efficiency and very low first cost.

The invention of the incandescent lamp marks the commencement of an era in which the possibilities of engineering will be extended to a degree of which we can, at present, have no adequate conception. Until the Edison lamp was invented and introduced, all distribution of electrical energy was by what is known as the series system, which did not lend itself readily to the development and use of electric motors. With the Edison lamp came the system of distribution on the multiple arc plan; and the commercial development of electric motors dates from that time.

The stationary electric motor, supplied from the lighting circuit, was naturally the first to come into use, on account of the number and simplicity of its applications. Then the motor was applied to propelling street cars, and the modern electric street railway system was rapidly evolved. The electrical engineer, in his search for "new worlds to conquer," next turned his attention to the mining field. The great variety of the applications in this field, the distance from the mines to the principal cities where electrical developments have been most rapid, and the lack of knowledge as to the exact requirements, have, until recently, made even the simplest applications of electricity to mining rather rare. Perhaps the greatest stumbling-block has been the percussion drill. When a mine owner asked if we could transmit his power, light his mine, and operate his pumps, hoists, tramways and mills, we could confidently reply, "Yes;" but until recently, when asked if we could replace or operate his air drills, we were obliged to say, "Not yet." Since the drill is the most universal of all mining appliances operated by power other than hand power, it was not possible to make rapid progress until this deficiency was corrected.

The Edison General Electric Co. has put upon the market in commercial form, during the past 30 days, three types of electric drills which will enable the mining engineer to accomplish all that he has been able to accomplish heretofore by other drills; and not only this, but to accomplish far more than was heretofore possible, and under conditions heretofore prohibitory.

THE ELECTRIC PERCUSSION DRILL.

First in importance comes the electric percussion drill, the invention of Mr. H. N. MARVIN, of Syracuse, N. Y. The following is a brief description of the principal features of this drill:

Fastened upon a suitable tripod or column is a piece of boiler tube 7 ins. in diameter and about 2½ ft. long. In the forward half of this casing are placed two hollow cylindrical coils of wire in the form of solenoids, each about 8½ ins. long, having an outside diameter of about 6¾ ins. so as to make a loose fit with the casing, and an inside diameter of about 2½ ins. These two solenoids are placed so as to be against each other end to end in the casing. The bit plunger plays freely through the center of these solenoids, and is supported by two bearings placed just beyond the outside ends of the two solenoids respectively. The back portion of the casing contains a spiral spring of the form frequently used for car springs. The plunger is composed of a central portion made of wrought iron about 14 ins. long, and both the forward and back portion of the plunger, which are made of aluminum bronze, are rigidly fastened to this iron portion. The forward portion is about 13 ins. long, and carries the bit socket. The back portion is spirally milled for a length of about 9 ins., so that the cross-section of this portion is hexagonal. At the extreme back end is a steel buffer which strikes against the cushioning spring. The spirally milled portion of the plunger is similar to that used in other percussion drills and causes the drill to revolve upon its axis one-sixth of a complete turn with each stroke.

The ends of the coils of wire are brought to contact pieces at the top of the adjacent ends of the two solenoids, where there is a socket for receiving the terminals of the cable, and thus making electrical connection with the drill. There are three conductors leading from the generator to the drill, one of which is connected to one terminal of each of the solenoids, and the other two conductors are connected to the two remaining terminals of the solenoids respectively. [The accompanying diagram will aid in making plain the mode of operation of the generator and drill.—ED.]

The generator is of the simplest kind, the coils on the armature having their terminals connected to two insulated collars on the shaft. One collar is a continuous metallic ring, and upon this rests a brush which is connected with that conductor which is common to both solenoids. The other collar is metallic for half of the circle, and the remaining half is insulated from the armature wires. Upon this half ring rest two brushes diametrically opposite each other, and each brush is connected to one of the two remaining conductors leading to the solenoids in the drill.

If we now revolve the armature of our generator in a separately excited magnetic field, an electric current will flow from the armature to the half ring, then through one of the two brushes which happens at the instant to be in contact with the half ring along the corresponding conductor to one terminal of one solenoid, let us suppose the rear one, then through the rear solenoid itself and back along the mutual wire to the continuous ring and then to the armature again. This current in passing through the rear solenoid makes a powerful magnet of it, and this tends to pull the plunger back into such a position that the center of its iron portion will be in the center of the rear solenoid.

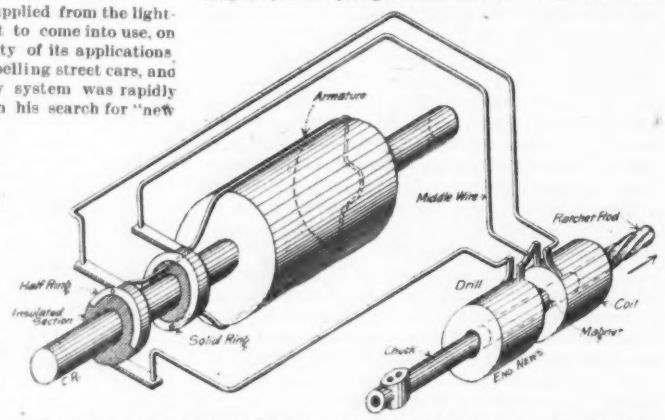


DIAGRAM OF EDISON ELECTRIC PERCUSSION DRILL AND GENERATOR, ILLUSTRATING MODE OF OPERATION.

When the armature moves forward a half revolution, the polarity of its wires is reversed, and the other brush with its conductor is now in contact with the half circle. Consequently, the current in the mutual wire will be in the reverse direction from that of the former wave. The rear solenoid and its conductor, formerly active, are now out of circuit; and the circuit is made through the other conductor and its corresponding solenoid, that is, the forward solenoid.

The magnetic action of this solenoid now tends to make the plunger move forward so that the center of the iron portion shall be in the center of the forward solenoid.

Thus we get a reciprocating action of the plunger, and every revolution of the armature of the generator will cause a complete stroke of the drill. By varying the speed of revolution of the generator we can make the drill strike any number of blows per minute we choose. In usual practice, 600 blows per minute is found to give excellent results. The spiral spring, it will be observed, stores up the energy of the back stroke and returns it to the forward stroke, assisting the magnetic impulse and greatly increasing the strength of the blow.

In order that we may form an unbiased judgment of this drill, I will quote the opinion of ANDRE, perhaps the best authority on power drills, who many years ago stated the desirable qualities in a first-class power drill to be as follows:

1. Simplicity of construction and strength in every part. 2. A small number of parts, especially moving parts. 3. Minimum weight consistent with strength and simplicity. 4. Minimum bulk. 5. Striking part of great weight compared with the rest of the drill, and striking directly. 6. Piston alone exposed to shocks. 7. Piston capable of variable length of stroke. 8. Ability to withstand without injury the sudden removal of the resistance. 9. Automatic rotary motion. 10. In automatic feed drills, feed regulated by the advance of the piston as the cutting advances. 11. Capability of working with moderate pressure. 12. Readily taken to pieces.

It may be sufficient to say that the Marvin drill possesses every one of the good qualities ANDRE specifies, and in a most marked degree; but, in describing the good qualities of this drill, we can, if necessary, add considerably more than ANDRE specifies; for example:

1. It is simple in construction and strong in every part. 2. It has a minimum of moving parts, that is, one. 3. It is very light in weight for its strength, this being possible because of the perfect cushioning at both ends of the stroke. 4. It takes up very little space. 5. The striking part is of relatively great weight and it strikes directly 6. The length of the stroke is variable at will. 7. The drill cannot damage itself by its own blow. 8. The rotary motion is automatic. 9. It has very few parts. 10. It can be entirely taken apart and put together again inside of ten minutes. 11. There are no joints to be fitted or packed. 12. It is not affected by heat or cold. 13. It can be operated at great distances from the source of power. 14. It has a much higher efficiency than other drills. 15. It is independent of the action of any valve. 16. The rate of striking is independent of the kind of material it strikes. 17. It will operate in the open air without striking anything, and hence can be made to strike an extremely light blow at its full rate, which is very important in starting holes, etc. 18. It can be rapidly moved from one position to another at a great distance since the energy is transmitted through flexible cables. 19. No loss is suffered due to elbows, bends, valves, etc., in the conductors. 20. The conductors can be carried on very light supports, both because of their light weight and because the transmission of energy through them does not tend to distort their position.

The importance of the above characteristics will be apparent to any one who is familiar with the operation of steam and air drills. It is interesting to note that in driving the Hoosac Tunnel, the average life of the power drills, before sending them to the shop, was 50 hours. Even to-day, after a development of 25 years, we find that it is common practice to have in the shop one-half the total number of drills employed.

In pushing engineering work, it is frequently of paramount importance that the work be done quickly. Therefore any means of greatly increasing the rate of drilling is extremely valuable. To increase the rate of drilling we must either increase the strength of each blow or else we must increase the number of blows per minute. A limit to the rate of striking is soon reached when a valve of considerable weight must be moved from rest by the concussion of the previous blow, and when a material substance, such as air or steam, must then fill the space back of the piston and raise the pressure to the working pressure. Also the strains and shocks caused by the valve and the air or steam soon become troublesome as we increase the rate of striking. With the electric drill the speed of rotation of a perfectly balanced cylindrical armature of small diameter has no such limitations, and there is apparently no limit to the rate of striking, except the magnetizing and demagnetizing of iron, which is already done in daily commercial practice at the rate of 10,000 times per minute with the highest efficiency. With 800 blows per minute we have already drilled at the rate of 4 ins. per minute a hole 1½ ins. in diameter in the hardest Quincy granite, and that with an expenditure of energy not exceeding 3 HP.

I firmly believe that in a comparatively short time we will be furnishing percussion drills whose rate of striking will be several times as much as that we now employ, and that with no more and no heavier drills than are now used, the rate of driving a heading will be increased many times. The importance of rapid driving of work is practically illustrated by the fact that in driving the Sutro Tunnel Mr. SUTRO offered the men at work, in addition to their regular wages, the following bonus:

For every foot per month over 300 and under 400.....	$ 5
For every foot per month over 400 and under 500.....	10
For every foot per month over 500.....	20

A recent bulletin from the Census Department [reviewed in ENGINEERING NEWS of May 2] shows that in granite quarrying the cost of labor is 84% of the total cost of production; and in Massachusetts, where the output is much greater than in any other state, and where the longest experience and most approved methods are met with, the labor is 82½% of the total cost. It will be evident that any labor-saving device in such a field will be extremely valuable.

(*Continued on page* 475.)

* A paper by H. WARD LEONARD, read April 29 before the Association of Mining Engineers of Quebec.

PERSONALS.

Mr. L. J. H. GROSSART has been elected City Engineer of Allentown, Pa.

Mr. F. VALDES, formerly an engineer on the Piedmont & Cumberland R. R., died at Ebensburg, Pa., recently.

Mr. S. C. WEISKOPF has been appointed Engineer and Eastern Agent of the Keystone Bridge Co., Pittsburg, Pa.

Mr. G. E. CUMMINGS has been appointed Assistant Superintendent of the Concord & Montreal R. R. north of Concord, N. H.

Mr. NATHAN LITTAUER, a Director of the Fonda, Johnstown & Gloversville R. R. Co., died in New York, N. Y., May 8.

Mr. SAMUEL G. ARTINGSTALL, M. Am. Soc. C. E., of Chicago, Ill., has been elected Chief Engineer of the Chicago Drainage District.

Mr. E. H. KEATING, City Engineer and Superintendent of Water-Works of Halifax, N. S., has been appointed City Engineer of Duluth, Minn.

The City Engineer of Boston, Mass., is Mr. WILLIAM JACKSON, Boston, instead of ANDREW JACKSON, as inadvertently stated in our issue of May 9.

Mr. S. B. HAUPT, Superintendent of Motive Power of the Norfolk & Western R. R., and Superintendent of the Roanoke Machine Works, of Roanoke, Va., has resigned.

Mr. CHAS. L. GATELY has been elected Secretary of the Safety Car Heating & Lighting Co., of New York. He has been connected with the mechanical department of the company for 3 years, as Assistant Engineer, in charge of construction of Pintsch gas works in different parts of the country.

NEW PUBLICATIONS.

—Irrigation Development. History, Customs, Laws and Administrative Systems Relating to Irrigation, Water-Courses and Waters in France, Italy and Spain. Part I. Irrigation in Southern California. The Field, Water Supply and Works, Organization and Operation in San Diego, San Bernardino and Los Angeles. Part II. By WILLIAM HAMMOND HALL, ex-State Engineer of California. Sacramento, 1886 and 1888. Printed by the State. Cloth, 6½ × 9 ins.; pp., Part I., 622; Part II., 672, with illustrations, folding maps and plates; $2.75 per volume, or $3, post-paid. For sale by E. G. WAITE, Secretary of State, Sacramento, Cal.

Although one of these volumes was published five and the other three years ago, they have but recently been distributed for review, owing to certain complications which need not be mentioned here. The sub-titles give a general idea of the contents of the volumes, and their broadness is warranted by the extent and detailed character of the work.

The first volume contains an elaborate study, scientifically presented, of the irrigation laws and customs of France, Italy and Spain. The study is so divided into chapters and subdivided into sections as to make comparisons between the different countries easy. Each section is intended to be complete in itself, the work having been prepared for busy men.

A further idea of Part I. is given by the analysis of Section I., the chapter on Governmental Policy and Irrigation Concessions in France, which is as follows:

Political and social conditions; irrigation not made a general national work; contrast between the case of France and those of India and Egypt; forms of governmental encouragement: tax rebate on advanced values due to irrigation; loans advances, subsidies, guarantees; main works built for associations; main works built for state management; premiums on irrigation examples; statistical atlas of irrigation.

The second volume contains 18 reproductions of photographic views of dams, reservoirs, flumes, trestles and tunnel portals connected with irrigation works in California. The volume also contains drainage area and rainfall distribution maps of California, and an outline irrigation map of the irrigation area of Los Angeles and San Bernardino Cos. In addition to the above there are 12 folding plates presenting plans, elevations and sections of dams built in various parts of the world for the storage of water. These dams are of masonry and concrete, earth, rock and crib-work.

Each of three counties treated of in the second volume has one chapter describing the irrigable regions and several chapters devoted to irrigation works and projects.

The descriptions of irrigation works are grouped about the streams from which water is taken, and include histories of the several enterprises and detailed facts regarding the character and extent of the works, their cost, operation and maintenance and terms on which water is furnished to irrigators.

The above is intended to give only an outline of the contents of these two volumes. The value of the work is obvious, but further comment on this subject and on the causes which led to the publication of the work will be given in a following issue.

—The Cleaning and Sewerage of Cities. Sewerage, Sewage Disposal, Street Cleaning. By R. BAUMEISTER, Professor at the Technical Institute of Carlsruhe. Adapted from the German, with permission of the author, by J. M. GOODELL, Associate Editor ENGINEERING NEWS. New York. Engineering News Publishing Co. Cloth, 8vo., pp. 281, 222 cuts and folding plate. $2.50.

A comprehensive and concise work on municipal sanitation has been asked for so often by the readers of this journal that the publishers decided to issue an adaptation of the recently issued work of Prof. BAUMEISTER on the subject. The German edition has already met with a very flattering reception abroad and in this country.

In issuing an American edition, which is done by special arrangement with Prof. BAUMEISTER, the aim has been to give the information in the original in the simplest form consistent with a reasonably close adherence to the German text. The present book is, therefore, a close adaptation, rather than an exact translation. In order to make the work complete from an American point of view, a chapter on the current practice here has been abridged from the papers on the subject that have appeared in ENGINEERING NEWS.

The proof-sheets of the present volume were read by Mr. RUDOLPH HERING, who kindly supplied an introduction to the whole work. From this introduction we take the following statements of the scope of the book, as it is hardly appropriate that we should critically review it in these columns:

The literature on sewerage and allied subjects is quite extensive. Even in America numerous publications have appeared, covering more or less thoroughly certain special systems or questions which have arisen from time to time. Much of our literature is in the form of reports or is contained in periodicals and in the proceedings of societies; but no general and comprehensive treatise on sewerage has yet appeared in this country. The publishers of the present volume have therefore done a good service in preparing for American readers a translation of Prof. BAUMEISTER'S recent work.

The author, whose name is already familiar to a number of American engineers, is well versed in the subject, though not a practicing engineer. His object has been to present in a compact form the elementary principles which govern all the usual practical questions, rather than to dilate on the more intricate problems which occasionally arise. His impartiality, characteristic thoroughness and judicial temper have fitted him to present the subject-matter, concerning which all controversy has not yet ceased, in a more balanced and scientific form than I have seen in any other book.

In using this book for practical purposes, the American readers should realize that it was written primarily for German engineers, and for conditions prevalent in the German Empire. Although the collection, treatment and disposal of sewage must accomplish the same object in every civilized community, we must remember the fact that social customs, domestic appliances, climate and rainfall are in some respects different from what they are in our own country, which will modify some features of the works.

After stating the general principles governing grades, depth, outlets and alignments, the author, in chapters 2 and 3, enters upon the question of the quantities of sewage and rain-water to be provided for. It is asserted that German practice in designing water-works is to allow 40 galls. per head per day. In America the water consumption is much greater, and also varies in different cities, reaching in some instances more than three times the above amount.

The character of the sewage, its chemical composition and dilution, will vary correspondingly. Likewise the data concerning rainfalls and the amount reaching sewers are not entirely suitable for American conditions. We have heavier downpours, and they are more frequent than in Europe.

The methods, however, according to which these data are to be weighed and applied are well presented, and their description thus furnishes information which is, of course, equally applicable to our own conditions.

The chapter on the shape of sewers describes more completely than I believe is found in any single publication, the characteristic forms for various conditions occurring in practice. The chapter pertaining to the methods for the calculation of sizes embodies the latest and best formulas and convenient diagrams to facilitate the necessary computations.

The details of construction, such as manholes, lamp-holes, junctions, overflows, siphons, and outlets, are fully treated and well illustrated, with a view to showing the proper variation in the designs for different conditions. These details are applicable and many will be equally serviceable in American practice. The remarks on relief outlets or stormwater overflows are particularly useful.

The chapter on catch basins and street water inlets de-

—The Slide Rule. By WM. COX. New York, Keuffel & Esser. 8vo, pp. 30. 50 cts.

This is a reprint, considerably expanded and with much detail added, of some articles which Mr. COX has contributed to this journal, and which, we need not say, are regarded as excellent. It constitutes a useful manual of the slide rule, and for practical use the best one extant.

Artistic Homes in Country and City, with Other Examples of Domestic Architecture. By ALBERT W. FULLER and WM. ARTHUR WHEELER. Architects. 5th and revised edition. Boston, Ticknor & Co. Oolong. 4to, pp. 70, heliotype plates. $6.

The reviewer expects a considerable task on taking up this bulky volume, but is agreeably surprised to find that it consists within, not even of a "rivulet of text," but of plates only, these being preceded by a brief "introductory note" only. The plates are divided into approximately equal thirds of extensions, interiors, and floor plans, and show some fine effects, especially in the interiors, but as they are confined to the works of a single firm of architects they do not call for critical notice.

—Municipal Bonds. A Treatise on Investment Securities. By EBEN HOWARD GAY, Boston. 1891. Damrell & Upham, publishers. Pamph., 5½ x 7½ ins.; pp. 43; 50 cts.

This pamphlet seems designed to show the superiority of municipal bonds over other forms of investment securities. All the more common classes of bonds are discussed, and court decisions regarding some of them are given. The writer cites as proof of the greater security of municipal bonds the fact that the bonded indebtedness of many municipalities is limited to 5% of their assessed valuation, while the latter is generally not more than one half the actual valuation. The work seems intended more especially for amateur investors, though, in view of past failures of bankers and brokers, and the securities some of them were carrying, it would seem that this class could learn much from the book. At the close of the pamphlet notable recent advances in the price of municipal bonds in nine cities are given. As an example of these, it is stated that Birmingham, Ala., 6% 30-year bonds were worth 1:9 in 1885, and 123¾ in 1890.

TRADE PUBLICATIONS.

—Locomotives.—Catalogue of the Schenectady Locomotive Works, Schenectady, N. Y., 1891. Leather, 8 × 4 ins. Fully illustrated.

This is a very handsome catalogue, with well executed phototype illustrations. The first few pages are devoted to notes on the company's work and specialties, with general specifications. The illustrations include the following, the leading dimensions and particulars being given in each case: 7 eight-wheel, 13 ten-wheel (4 compound), 9 consolidation (1 compound), 4 mogul, 1 twelve-wheel (6 drivers), 7 switch engines with tenders, 6 tank engines, 1 dummy engine and 1 inspection engine. The compound engines are of the two-cylinder type, fitted with the intercepting valve invented by Mr. A. J. PITKIN, Superintendent of the Works. The book could be easily made very valuable by the addition of explanations and some details of the most notable engines illustrated, including the twelve-wheel engine and the compound engines, with particulars of the work for which such engines are designed. No mention is made of the Strong engines built at these works. The works were established in 1848, and have a capacity of 120 locomotives per annum.

SOCIETY PROCEEDINGS.

New York Railroad Club.—At the meeting on May 21, at 2 P. M., papers will be presented on "Improvements in Switches, Switch Stands and Frogs," by Mr. W. F. Ellis, and on "Drafting Locomotives," by Mr. Geo. W. West.

Liverpool Engineering Society.—At the meeting on April 22, Mr. F. Hudleston, President, in the chair, Mr. George Farren, A. M. Inst. C. E., read a paper entitled "Inundations at Aber-Menai, Anglesea," dealing with the question of the washing away by the sea of a large body of sand hills which previously formed a natural breakwater across the entrance of the Menai Straits, near Carnarvon, and with the engineering details of the various schemes which had been adopted by the Carnarvon Harbor Trustees for the preservation of this natural breakwater.

Engineers' Club of Cincinnati.—The regular meeting was held on April 16, with 28 members and several visitors present. The following question received considerable attention from various members: "On reasonably firm subsoil, which form of curb is to be preferred in street construction: 5 × 14-in. curb on 6 ins. concrete foundation with concrete backing to within 3 ins. of the top, or 5 × 21-in. curb on clay or 2 ins. of gravel with earth backing, difference in cost being 10% in favor of the shallow curb."

Mr. A. Petry read a paper giving a description of the apparatus used and the manner of measuring the amount of water delivered to the reservoirs by the pumping engines forming a part of the new water-works plant being erected by the city of Covington.

American Railway Master Mechanics' Association—Master Car Builders' Association.—At the joint meeting of the Executive Committees of these associations, held in New York, May 7, a resolution was unanimously adopted expressing confidence in the efforts Mr. Walton, proprietor of the Stockton Hotel, Cape May, is making to accommodate the annual conventions. This was done after Mr. Walton had explained in detail his method of assigning rooms and his charges. The committees were satisfied that any person who does not call for a selected room can have room and board for $3 a day. The Car Builders' Association will meet June 9 at 10 A.M., and the Master Mechanics' Association will meet on June 16 at 10 A. M. Those desiring to engage rooms at the Stockton Hotel for the Master Mechanics' convention should address the Secretary, Mr. Angus Sinclair, 140 Nassau St., New York. Those desiring rooms during the Master Car Builders' convention may address F. T. Walton, Jr., 124 So. 21st St., Philadelphia. It is stated that besides the Stockton Hotel, the Lafayette, situated about 200 yds. from the Stockton, and the Shoreham, at Cape May Point, 8 minutes distant by a steam motor line, will receive guests at the convention rates of $3 per day and that rooms can now be engaged by addressing the proprietors of these houses.

For the exhibit of railway appliances, a temporary building will be erected on grounds adjoining the Stockton Hotel, space in which will be rented to exhibitors at the uniform rate of 25 cts. per sq. ft. The exhibition areas will be 6 ft. in depth, making the cost of space $1.50 per front foot. The size of the building will depend upon the space engaged, and exhibitors are requested to apply at once to Mr. F. T. Walton, as above, stating the space desired. Tables and chairs will be furnished at cost price to those requesting, and steam will be furnished by special contract.

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AND

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Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—May 16. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania.—May 19. Secy., J. H. Harlow, Pittsburg, Pa.

Engineers' Club of St. Louis.—May 20. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Boston Society of Civil Engineers.—May 20. Secy., S. E. Tinkham.

Western Railway Club.—May 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Club of Cincinnati.—May 21. Secy., J. F. Wilson.

New York Railroad Club.—May 21. "Improvements in Switches, Switchstands, and Frogs. Drafting Locomotives." Rooms, Gilsey House. Secy., H. G. Prout.

American Society of Civil Engineers.—Annual meeting, May 21, at Lookout Mt., Tenn. Secy., Francis Collingwood, 127 E. 23d St., New York.

Denver Society of Civil Engineers.—May 26, "Steel." Secy., Geo. H. Angell.

Civil Engineers' Society of St. Paul.—June 1. Secy., C. L. Annan.

Western Society of Engineers.—June 3. Secy., J. W. Weston, 280 La Salle St., Chicago.

Engineers' Club of Minneapolis.—June 4. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Technical Society of the Pacific Coast.—June 5. Secy., O. von Geldern, 819 Market St., San Francisco.

Association of Civil Engineers of Dallas.—June 5. Secy., E. K. Smoot, 803 Commerce St.

Northwest Railroad Club.—June 6. Secy., H. P. Robinson, St. Paul, Minn.

Engineers' Club of Kansas City.—June 8. Rooms, Baird Building. Secy., H. Goldmark.

Civil Engineers' Club of Cleveland.—June 9. Secy., A. H. Porter, 50 Euclid Ave.

Civil Engineers' Association of Kansas.—June 10. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—June 10. Secy., F. M. Curtis.

Engineering Association of the South.—June 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—June 12. Secy., D. W. Meeker, St. Paul, Minn.

American Railway Master Mechanics' Association.—June 16. Annual Convention, Cape May, N. J.

THE complete fiasco which we predicted would be the only result of the late encouraging effort to improve New York street-cleaning practice has now come to pass. Mayor GRANT has made public a "reply" to the elaborate report of his Advisory Committee on Street Cleaning, which, for calm impudence and unblushing assurance, can hardly be matched even in the annals of Tammany. He declares in plain words that there is little need for improvement anyway. The work of the Street-Cleaning Department "is now better performed than at any previous time since its creation, and the streets are," *according to universal testimony* (italics ours) better "swept now than at any time before;" "New York is the best cleaned of American cities," and "compares favorably" with most European cities also! The Mayor does not approve of paying the permanent force of laborers so little as $40 per month, not because competent men would not volunteer in crowds for such employment, but because (italics again ours) it is "less than could be made *by any good workman at his trade*." The Mayor also objects very strongly to having any civil service in his'n. He thinks it is not lawful and not "judicious." He wholly disapproves of any registration or classification of the working force or of aspirants thereto by an authority outside of the department which employs them. Of course he does; there was never yet a Tammany politician who did not. But the Mayor has no objection to a good-sized force "properly appointed;" not at all. Taken for all in all, with its outward show of respectful consideration and its ever-present undercurrent of cynical contempt, it is as amusing yet irritating a document as has emanated from a city politician for many a day. The "Advisory Committee" may well declare, "If we were so soon to be done for, O what were we ever begun for," and the suffering citizen can only murmur, "How long, O Lord, how long?" Discussion on the merits of the Mayor's production would be an absurd waste of time. It is merely Boss TWEED'S "What are you going to do about it?" over again.

A NEW journalistic venture, under the title of the *Engineering Magazine*, makes its first appearance this month, and a very creditable one it is. The experiment whether engineering questions can be treated in a popular way, so as to command popular support without repelling engineers, is about to be fairly and well tried, it would seem, and we shall watch with interest the result, wishing to the new enterprise all success. The idea seems to be to imitate in form, style of engravings and general tone of the articles our best illustrated magazines, but to confine the contents to articles on engineering or architectural subjects, and to give at the end of each number some 30 or 40 pages of more strictly technical matter in the form of "Engine-Room Chat," and like notes on civil engineering, architecture, electricity and metallurgy. The obstacle to be overcome in conducting such an enterprise is much like that which an acute observer once declared to stand in the way of Unitarianism—"It is too much like religion for those who do not want any, and not enough like it for those who do." In the effort to make the contents of the magazine technical enough to suit those who make engineering a profession, yet not so technical as to repel those who do not, there is demand for great good judgment; but on the other hand, the price is very reasonable, $3 per year, and there is an immense multitude of men in this country who are not themselves engineers, but who feel more or less interested in it, and will welcome some royal road to as much technical learning as they desire. We are frank to say that the editor has steered very judiciously between his Scylla and Charybdis in his opening number, as also in a previous one published under the title of *Engineering*, which latter improper appropriation of the name of a well-known journal he has done well to think better of. Both of these issues contain, not one alone, but several articles which the engineer and non-engineer alike can read with interest; and so long as the magazine fulfills its early promise we are sure that most of our readers will find it to their advantage to buy and read it. We are glad to see that it wholly eschews the detestable practice of wholesale cribbing from foreign periodicals on which prior ventures in this field have so largely relied.

A RESOLUTION was adopted at the meeting of the Western Traffic Association in this city last week, which, if carried out and made successful, promises to have results of the greatest importance in reducing the expenses and increasing the earnings of the railways, and in putting a stop to the discriminations, the secret rate cutting, and similar evils of the railway service which still flourish in spite of the Interstate Commerce law.

This resolution, after reciting that the work of the Association in introducing reforms is greatly hampered by the uncertainty attending its existence, and that its life ought to be extended at least to Jan. 1, 1896, continues as follows:

> That the commissioners be directed to prepare a plan by which, as far as may be possible, independent agencies shall be abolished and joint agencies established where and whenever found necessary to lessen the expenses attending the competitive business of the members of this association.

The amount of money which is expended by the railroad companies in maintaining a staff of officials whose sole duty is to "drum up business" is not generally realized. Mr. STICKNEY'S recent book on "The Railway Problem" sets forth this evil in the following vivid manner:

> Each railway manager has surrounded himself with a standing army of freight and passenger agents, contracting agents, soliciting agents, advertising agents, clerks, typewriters, and runners. In every important city and in many unimportant towns, detachments of each of the companies have been permanently quartered, occupying the most expensive offices at the most conspicuous corners of the most important streets. No expense has been spared to equip them with the latest and most expensive arms. The arts of the printer, the lithographer, and the engraver on wood and steel have been exhausted. Theatre tickets, credits at livery stables, and "et ceteras" have been supplied without stint, and "no questions asked."

The comparison of a railway's traffic agents to a standing army was a most happy one; for just as the nations of Europe are each obliged to maintain great standing armies because every other nation does, so each American railway is obliged to do as its competitors do in maintaining agencies at competitive points and using unlawful methods to secure traffic. No single railway, however powerful, can afford to withdraw its agents at competitive points and take only such business as the traffic agents of its competitors will leave.

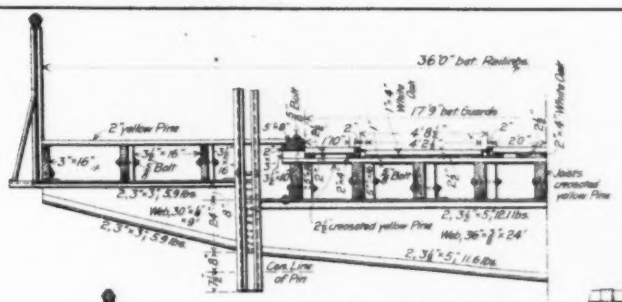
The exact expense of these competitive agencies and the total amount spent by the railways in "getting business," are not easy to obtain. Taking up at random, however, the Illinois Railroad Commissioners' Report for 1888, and turning to the report of operating expenses of the Chicago & Alton R. R., we find charged:

Agencies, including salaries and rent	$94,518
Commissions paid	84,424

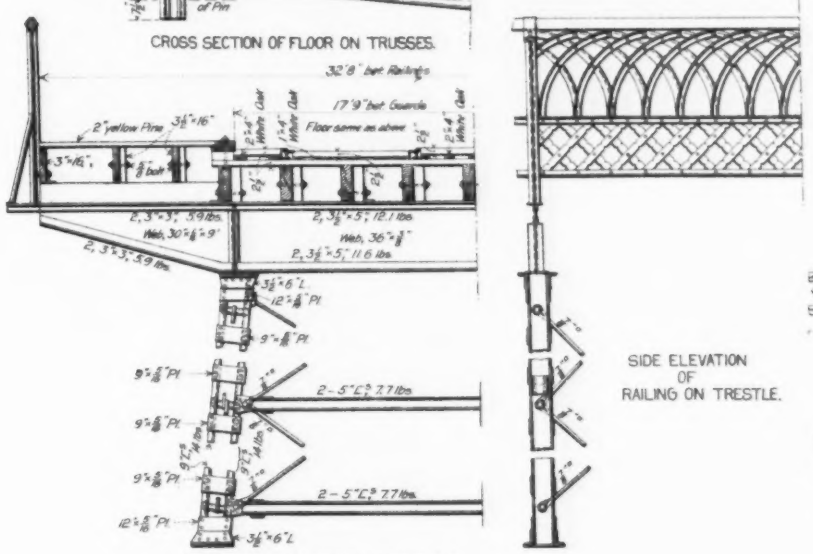
Or a total of $178,942, which was about five per cent. of the total operating expenses of the road and nearly 14 per cent. of the total profits of the road after paying fixed charges.

BUT great as is the direct cost of maintaining these expensive traffic agencies, the indirect cost is much greater. How is it to be expected that traffic shall be equitably divided among the railways, and how shall secret rate cutting in its various forms, and the rate wars which results from it, be stopped, so long as each railway company maintains an expensive staff of salaried officials whose duty it is to obtain traffic by fair means or foul, and whose work it has been for many years secretly to "get around" the agreements to maintain rates and even the laws establishing them.

United action alone can do away with this evil, and this united action the Western Traffic Association proposes to take. Whether the co-operation of all parties concerned can be secured remains to be seen. It will doubtless be a difficult

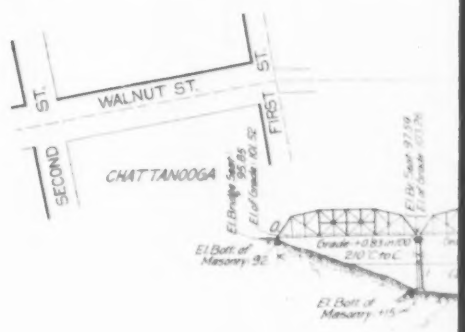


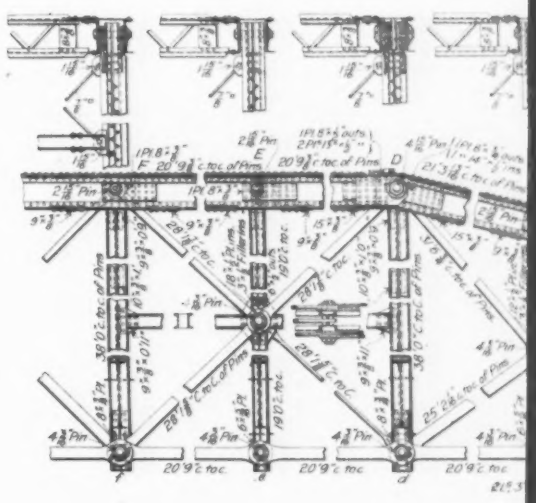
CROSS SECTION OF FLOOR ON TRUSSES.

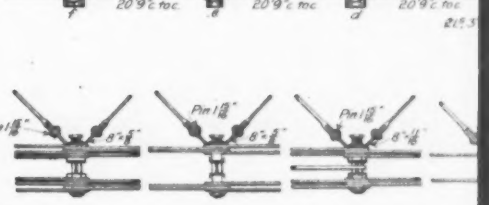


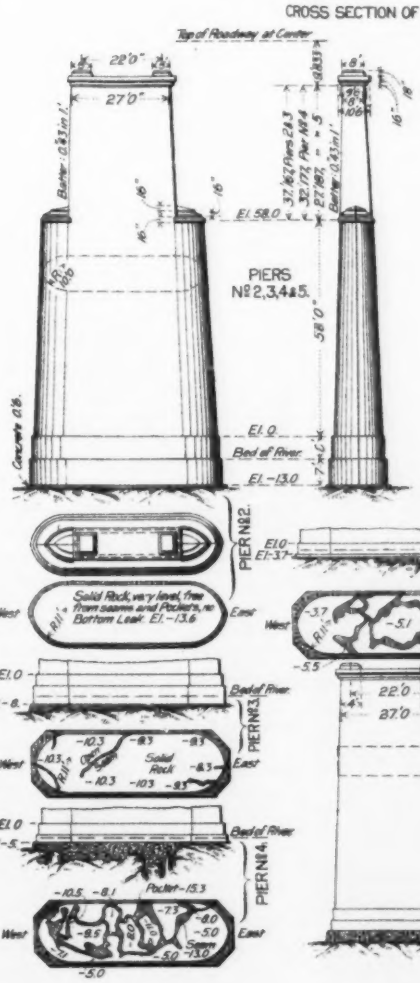
CROSS SECTION OF FLOOR ON TRESTLE.

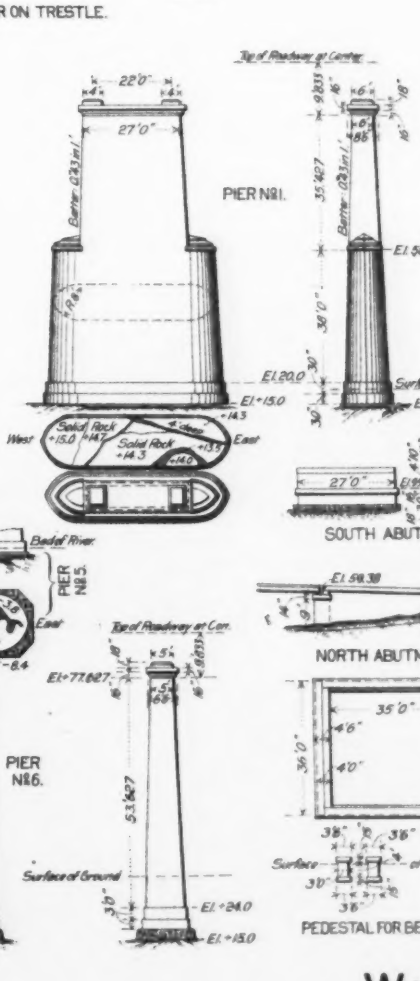
SIDE ELEVATION OF RAILING ON TRESTLE.

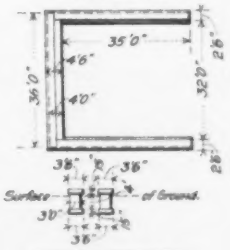


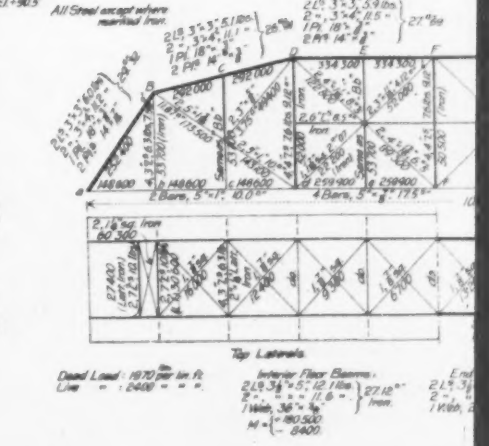












WALNUT STREET BRIDGE OVER T

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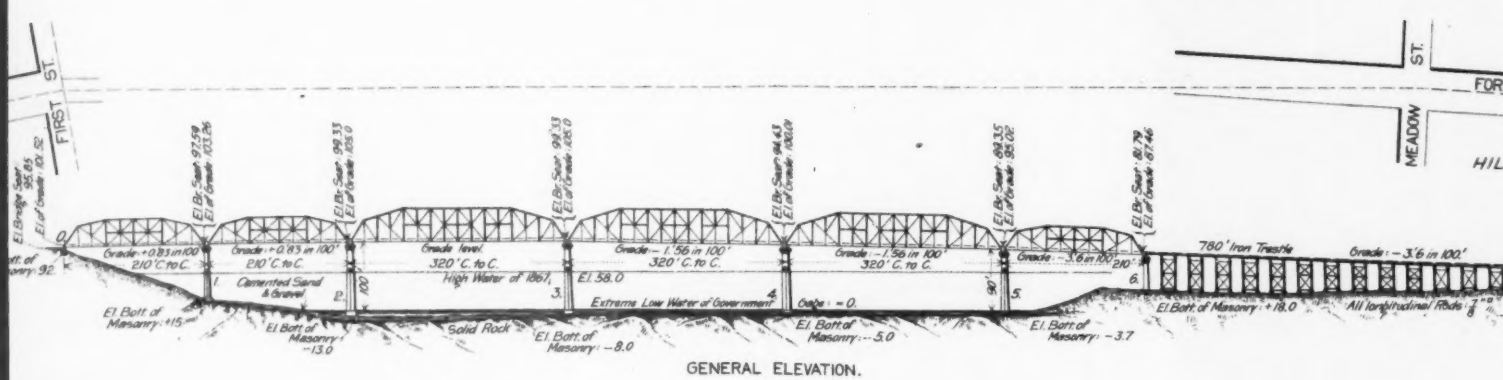
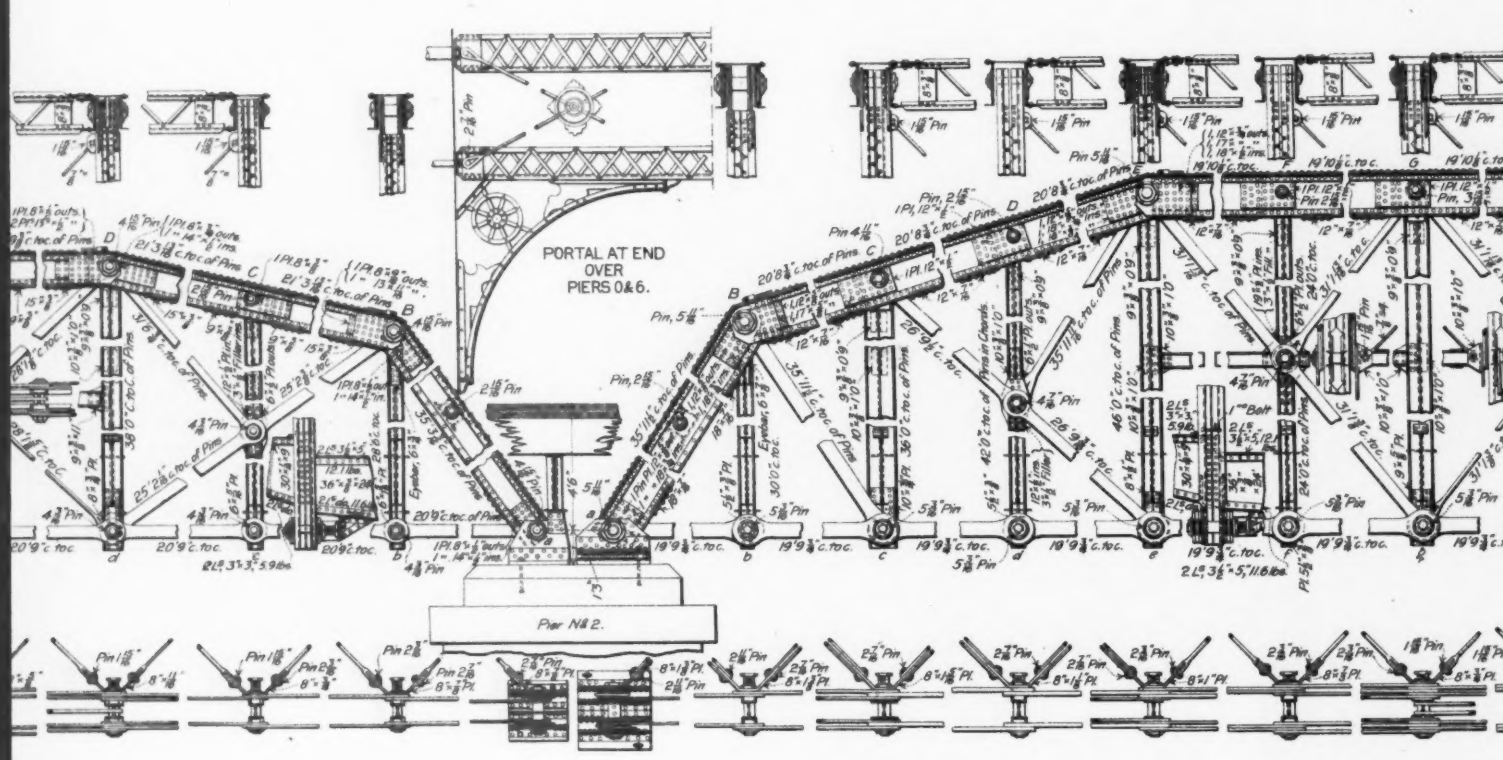
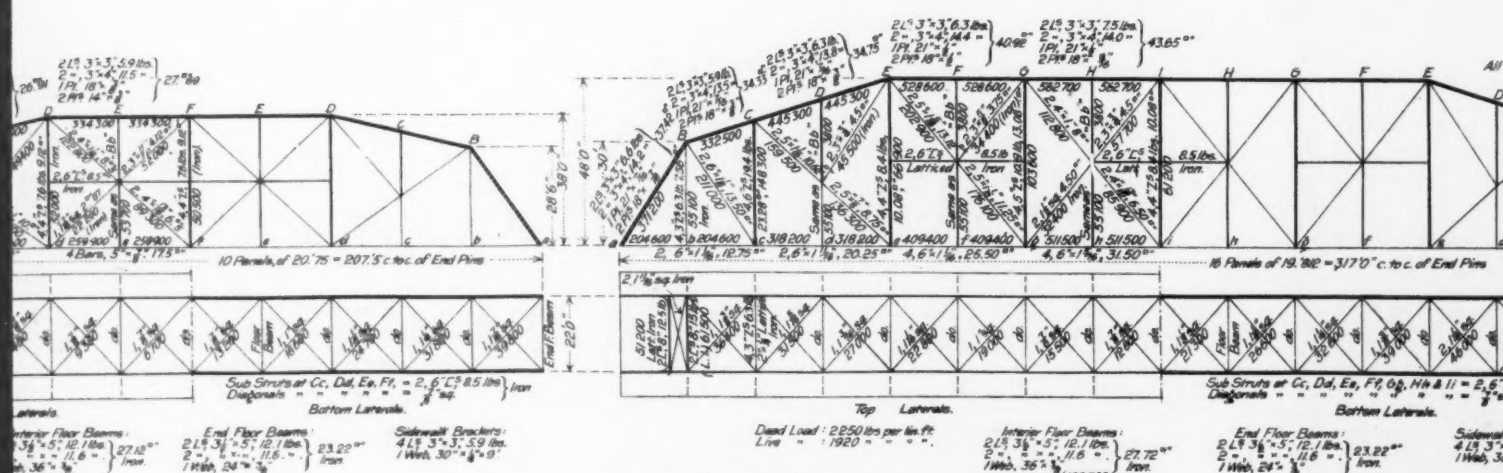
SMITH BRIDGE CO., CONTRACTORS FOR SUPERSTRUCTURE.



GENERAL ELEVATION.



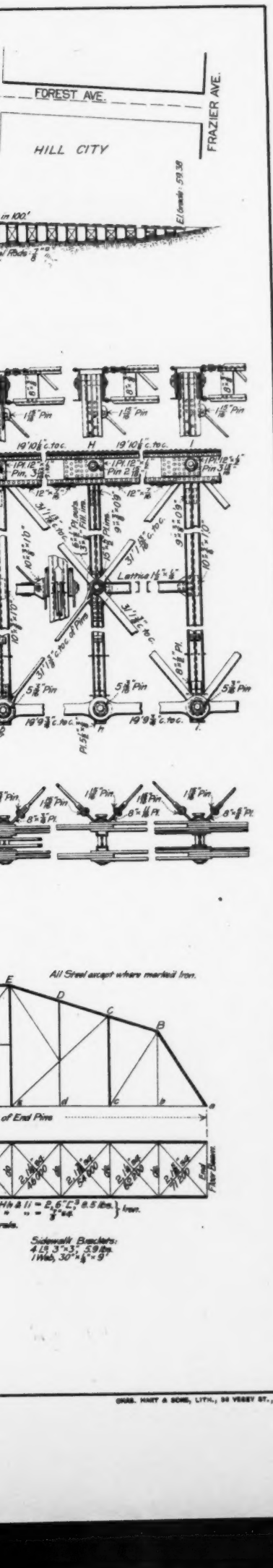

10 Panels, of 20'.75 = 207'.5 c. to c. of End Pins
16 Panels of 19'.812 = 317'.0" c. to c. of End Pins
Sub Struts at Cc, Dd, Ee, Ff = 2, 6" L 8.5 lbs. Iron
Diagonals " " " " " " = 7/8" sq.
Bottom Laterals.
Top Laterals.
Dead Load: 2250 lbs per lin. ft.
Live " : 1920 " " " ".
Interior Floor Beams: 27.72" Iron.
End Floor Beams: 23.22" Iron.
Sidewalk Brackets: 4 L 3" x 3" x .59 lbs. / Web, 30" x 1/4" x 0"

STRAIN DIAGRAMS.

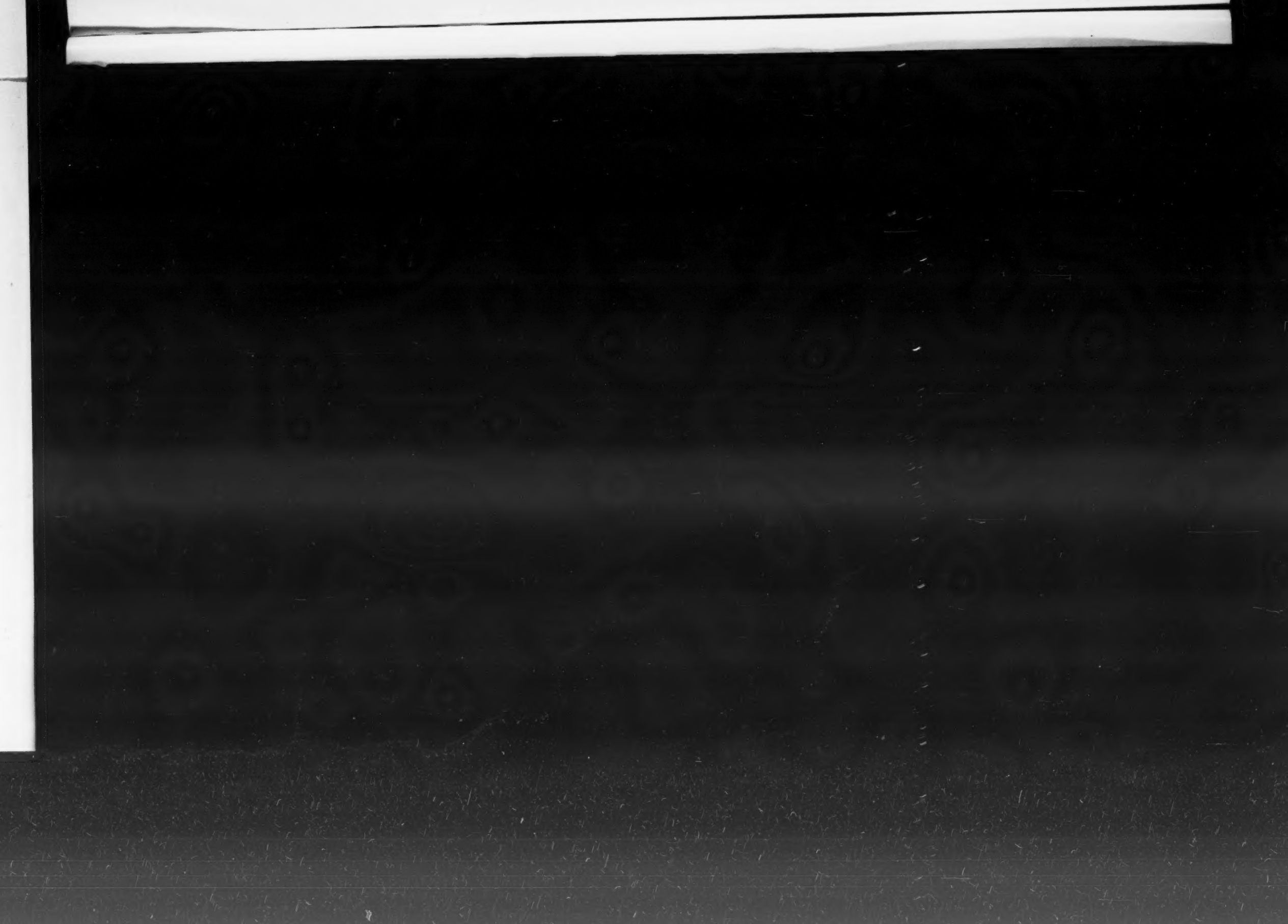
...OGE OVER TENNESSEE RIVER, CHATTANOOGA, TENN.

EDWIN THACHER, CHIEF ENGINEER.

...FOR SUPERSTRUCTURE. NEELY SMITH & CO., CONTRACTORS FOR SUBSTRUCTURE.



CHAS. HART & SONS, LITH., 30 VESEY ST., N.Y.



matter to secure the abolition of the army of traffic men who have so long drawn comfortable salaries and have "helped themselves" by other methods which will not bear investigation. The influence of these men with the higher officials is very considerable, and there will doubtless be a decided kick against the abolition of their lucrative positions. But it is gradually dawning upon the public, and upon railway officials as well, that transportation is a commodity which should not be hawked about the streets, nor sold at one price one day and another the next. The reform which has been started, therefore, has promise of eventual success, even though the present attempt should end in failure.

WE feel in duty bound to call the special attention of such of our readers as are interested in car lighting or the safe handling of trains to the installment, which appears this week, of our series of articles on car lighting, and especially to the incident described in the concluding part of it. We do this without prejudice. We have no knowledge whatever of what occurred in the incident referred to, beyond what is conveyed in the newspaper records quoted. They may be entirely incorrect in their substance, as they certainly are in some of their minor details. Our columns stand wide open for any correction of the statements, in whole or in part, which may appear from a competent authority, or from any person whatsoever who claims to be well informed as to the facts. It has already been pretty well established, in our judgment, that in one great railway wreck in which the "dry carbureter" system of lighting cars by the vapor of gasoline figured, and in which it was at first supposed that the gasoline was the cause of the fire, it was not the cause of it, and, moreover, had little or no effect to even aggravate the disaster. This wreck was at Thaxton, W. Va., February, 1890. The fire of last week on the Georgia Central, as chronicled elsewhere, may be, another case in which the effect of the gasoline to start a fire has been exaggerated if not misrepresented.

But the internal evidence of the record, it seems to us, is all against this conclusion. The main facts of the incident as narrated seem too entirely consistent with the nature and properties of free gasoline vapor to have been manufactured by an ignorant reporter, and as such, whether true or false in its minuter details, the incident shows that careful consideration and *extreme caution* are necessary before deciding to begin, at least, the use of gasoline in cars as an illuminant. Facts not yet known outside a very limited circle, and which are now being made the subject of further experiment, so that we cannot now state them in detail, tend still further to enforce this conclusion. Precisely what conclusions these facts indicate we cannot now state, nor do we even know, or allow ourselves to form an opinion, pending the completion of the further experiments referred to; but this much at least is now certainly known, that *deliberation* and *caution* are warranted and demanded, because it has been already determined that under certain conditions which have obtained and do obtain in practice, the functional action of the plant is different from what has been supposed or announced to the public.

We learn since this article was in type that the Georgia Central has ordered the plant removed from its cars.

The Water Supply and Sewerage of Plainfield, N. J.

A curious and not altogether creditable complication has been developed recently at Plainfield, N. J., in connection with the proposed water-works. Sometime ago Mr. CHARLES E. MOORE began the construction of water-works to supply the city. Mr. RUDOLPH HERING, of New York, was engaged to look after the interests of the city. Mr. MOORE developed a water supply from wells at Netherwood, and had a pumping station well under way, when he was obliged to suspend operations because he could not sell the securities of his company. The latter difficulty was caused by the fact that the Plainfield Water Supply Co., which was chartered by the legislature in 1869, had kept up its charter rights and stood ready to build works, and proposed to do so. Mr. MOORE finally sold his partially constructed works to the Plainfield Water Supply Co., and took his pay in cash and securities. This company at once completed the pumping station, erected its stand-pipe, bought its pumping machinery and distributed its street mains.

At this juncture the City Council passed an ordinance in accordance with provisions of its charter prohibiting the Water Supply Co. from tearing up the streets. A "combine" in the Council of 6 to 5 then granted a franchise to Mr. J. M. LOW, of Kingston, N. Y., for both water-works and sewers. Under existing laws it was necessary to secure the consent of one-half of the property holders before the new company could begin the construction of sewers. This consent could not be obtained. The "combine" then secured the passage of a law at Trenton permitting the Council to authorize the construction of sewers without the consent of property holders.

Having carried matters thus far, an injunction was secured restraining the Plainfield Water Supply Co. from tearing up the streets. The charter of the Water Supply Co. antedated the city charter by three years, and the company claimed that the rights granted in its charter could not be taken away by the ordinance already mentioned. Justice VAN SYCKEL, of the State Supreme Court upheld this opinion.

The heaviest tax-payers are in favor of the Plainfield Water Supply Co. and against the new company, we are informed and believe, for several good and sufficient reasons, one of which is the following:

The Plainfield Water-Supply Co. is composed of well-known men, commanding high respect in Plainfield. Four who may be named are: Mr. FRANK BERGEN, a lawyer of Newark and President of the company; Mr. JOHN W. MURRAY, Vice-President of the German-American Insurance Co.; Mr. WILLIAM RUNKLE, of the Warren Foundry & Machine Co., and Mr. O. T. WARING, of the Standard Oil Co., these three last-named being residents of Plainfield. The Water Supply Co. has for its engineer Mr. CHARLES B. BRUSH, of Hoboken, a man of large experience with water-works. The new franchise, as stated above, was granted to Mr. LOW, of Kingston, N. Y., who, as contractor, has built water-works at Fort Plain, Saugerties, North Tarrytown and Kingston, N. Y., all small towns except Kingston, but who has never built a sewer and who stated before the Council that he was not an expert in sewerage matters. He promises to put in a complete sewerage system, but another reason why the citizens are opposed to the LOW franchise is that they cannot find out what is proposed in the way of a sewerage system. Under the laws of New Jersey a private company cannot discharge sewage into a stream, and thus it is of the utmost importance that the plans for a sewerage system, if built and operated by a company, should be submitted to an expert for approval or amendment.

A large majority of the citizens are therefore opposed to the LOW franchise and works, so far as we can learn, and it is said that, if necessary, every possible legal device will be used to prevent the carrying out the LOW plan; but it is hoped that the court decision will do away with the difficulties and prevent the foisting of a water-works and sewerage system upon the people contrary to their wishes.

The press dispatches relating to the decision in favor of the Plainfield water supply contain one statement which displays the ignorance of the correspondent who sent it. After stating that Mr. LOW proposes to build his works, in the face of the adverse court decision, it goes on as follows, the italics being ours:

> He looks to the people to patronize his company, giving both water and sewerage, and to boycott the company which has been fighting the city, *and that promises to flood the town with water, but offers no system of pipes for taking the disease breeding sewage away.*

In another part of the dispatch the old company is referred to with the statement: "But it offered no system of sewerage to carry off the waste and surplus water." In addition to the above, the dispatch was headed, "Water without sewerage."

These statements imply that it is the general practice for water companies to construct sewerage systems co-extensive with their water mains, and the heading implies that all water mains are paralleled by sewers. Now, the facts are that not one-third of the cities and towns in the United States having water-works are provided with sewers of any sort, and there are only two cities in the United States—Natchez, Miss., and Shreveport, La.—where a water company has constructed sewers in connection with its water-works. Moreover, careful inquiries by this journal have resulted in establishing the fact that but five or six towns or cities in the country have sewerage systems built by private companies. In addition to the sewerage works already named, private ownership of sewerage systems prevails at Atlantic City, Asbury Park and Long Branch, N. J., and at Houlton, Me., the sewers in the latter place having a length of but 7,800 ft. In other localities sewers have been built by land or similar companies to assist the development of other property, and there are, of course, instances where residents of a street have clubbed together and built a sewer for their own service.

Private companies have heretofore made and are now making applications for sewer franchises, but such schemes do not meet with public approval, and from the very nature of a sewerage system private ownership is a dangerous expedient. No other form of public works seems so ill-fitted to be turned over to a private corporation for money-making purposes, a statement which is borne out by the fact that no well-managed municipality, or poorly-managed either, so far as we know, has ever attempted to derive a net revenue from its sewerage system, while many municipalities do aim to secure a revenue, above all charges, from their water-works.

The legal merits of the Plainfield case have been decided by the State Supreme Court. It is certain that the citizens are right in protesting against the construction of a sewerage system, the plans for which have not been openly presented for the inspection of all interested, and indorsed by eminent sewerage engineers. And even with the latter conditions fulfilled it would be a most doubtful policy, under any circumstances, to grant a franchise for a sewerage system to a private company. It is not a proper subject for private speculation, and in private hands is very likely to be ill managed or neglected.

The Edison Electric Percussion Drill.

The electric motor has now become a familiar machine, both to engineers and to the general public; but in all the varied forms in which it has been applied the motion produced is a rotary one, a fact which has been of no small importance in helping the electric motor's growth in popularity. There are some machines, however, to which the application of electricity has been delayed on account of the fact that a reciprocating motion, instead of a rotary one, was necessary. Inventors have been working for some time on reciprocating electric motors; and some of them have reached a practical solution, to the extent, at least, of getting their machines on the market.

One of the uses for a reciprocating electric motor which has promised greatest rewards to the successful inventor has been the driving of a percussion rock drill. In another column Mr. H. WARD LEONARD, of the Edison General Electric Co., has very well stated the peculiar advantages which an electric percussion drill offers, especially for mining use, where electricity is already applied for so many other purposes; and he gives a fairly complete description of the drill which the Edison Co. has just placed upon the market.

To more readily compare this drill with the best known makes of steam and compressed-air drills of similar capacity, we have compiled the following little table, taking the data in each case from the manufacturer's catalogue:

	Edison electric percussion drill.	Ingersoll "Eclipse" rock drill Size C.	Rand, "Little Giant" No 2 or "Slugger" No. 12.
Weight of drill unmounted, lbs.	400	227	200
Weight of tripod.		155	145
Tripod weights...	200	315	288
Total weight.	400	697	633
Diam. of cylinder.	.....	2¾ ins.	2¾ ins.
Length of stroke..	3 to 4 ins.	6¼ ins.	5 ins.
No. strokes per minute.....	600	325	... .
Length of feed....	20 ins.	20 ins.	18 ins.
Rate of work in hard granite...	2¾ ins. per minute in test at Quincy, Mass., March 27.	60 ft. in 10 hours, including time lost in setting drill and changing bits.	60 ft. in 10 hours, "Little Giant"; 80 ft. for "Slugger."
Power absorbed by drill	5 HP.	8 HP.*	7 HP.†
Price of drill and tripod complete	$550	$300	....

* "Size of boiler to run by steam." † "Best size of boiler to give plenty of steam."

The figures for rate of work, number of strokes per minute, power absorbed and prices of drills in the above table are understood to be approximations to average conditions, and subject to great change according to the circumstances of special cases. In comparing the power used by the drills, especially, it should be noted that the figures for the steam drills are for the size of boiler necessary to run one drill with ease. The actual power used, therefore, may not be much more than in the electric drill. Another point to be considered in comparing cost is the cost of the power plant by which the drills are operated. Mr. LEONARD gives the cost of an electric generator large enough to run six drills at $2,000. A boiler which would furnish ample steam for a half-dozen rock drills would cost, perhaps, not more than one-fourth this sum, and must be bought for the electric plant also, when water-power is not available, in addition to the engine and dynamo. On the other hand, if the drills have to be run by compressed air, the cost of compressors alone would equal the cost of an electric generator. The pipes for transmitting compressed air are also much more expensive than the wires which transmit electricity. In general, therefore, it appears that the electric drill will beat its well-established rivals in first cost in places where power to drive the drills has to be transmitted a considerable distance. For small plants, however, especially for temporary work, as in railway construction, the electric drill will apparently have to be considerably reduced in price to compete in first cost with drills driven by steam.

It is in reducing the cost of drilling, however, rather than of the plant, that the electric-drill manufacturers expect to have the chief advantage over their competitors. The electric drill has but one moving part, and it is claimed that breakages and the resulting delays and repair-shop expenses will be far less than with the steam and air drills. Although the claim seems a reasonable one, since the electric drill is exceedingly simple in construction, it will require the test of practical experience to determine just how much gain will be made in this direction. Perhaps some one will take exception to Mr. LEONARD'S statement that it is common practice on a work where air drills are used to have one-half the drills in the shop for repairs.

In the second place, it is proposed to increase the rate of working, both by making the drill more portable and by increasing the speed of drilling. As the above table shows, the former has been actually accomplished, the weight of drill and tripod complete being less than two-thirds that of an air drill of similar size. As to increasing the speed of drilling, Mr. LEONARD makes the very interesting statement that he expects in a comparatively short time that the Edison Co. "will furnish percussion drills whose rate of striking will be several times as much as that now employed." It will be seen that the number of blows per minute is already nearly twice that of the air drills; and to again increase the rapidity of striking to several times what it is now will be a highly important gain if practicable. Undoubtedly the electric drill possesses an enormous advantage over the steam or air drill for rapid striking in that the application of energy is practically instantaneous. In its older rivals the movement of the steam or air through the valves to fill the chamber at either side of the piston requires a certain time and interposes a limit to rapidity of working. Putting the case in another way, the pressure on the piston in a steam or air drill varies greatly at different points of the stroke. In the electric drill the force acting on the plunger is constant, from the instant of its application to the instant when it is reversed to pull the drill in the other direction.

But suppose it is desired to double the number of strokes per minute of the drill, the length of the stroke and the energy of each stroke remaining the same. The energy of each stroke of the drill equals $\frac{Wv_2}{2g}$, in which W = the weight of the drill and the plunger which drives it, and v = the velocity with which it strikes. But when the number of strokes per minute is doubled, the striking velocity is also doubled, and the striking energy is quadrupled. Hence, if the length of the stroke and its energy of delivery are to remain constant when the number of blows per minute is doubled, the weight of the drill and plunger must be but one-quarter what it was before. But in drilling holes of any considerable depth the weight of the drill cannot be much reduced. Practically, therefore, if it were attempted to double the velocity of the drill, either the energy of each stroke would have to be increased fourfold or the length of the stroke would have to be much shortened. It should be said, however, that the above calculation neglects the important but indeterminate element of the rebound of the drill at each end of its stroke from the rock and from the spring in the head of the drillcase. This "cushioning" has been found to be a factor of much importance in determining the length of stroke of the present drill; it may enable the speeds which Mr. LEONARD prophesies to be obtained in drilling holes of moderate depth. In putting down deep holes requiring heavy drill rods, however, the electric drill will do very well if it keeps up its present rate of speed.

Taking into consideration the various points of merit which are claimed for the electric drill, there seems to be no doubt that it is destined to come into extensive use. In some cases its superiority is manifest. For instance, on the railway now being built across the Andes between Chili and the Argentine Republic, nearly 10 miles of tunnels are being driven by compressed-air drills supplied with air from compressors driven by electric motors, which are in turn driven by a current from dynamos driven by water-power and located at a distance, in one case, of 7,000 meters, and in two other cases of 3,000 meters (or about 4.4 miles and a little less than 2 miles).

In other cases, as, for instance, in ordinary tunnel driving, the ventilation which the compressed air drills afford at the working face will be a strong point in their favor, no matter what superiority their new rival may show in other particulars, though ventilating fans may be substituted if the gain from the electrical drills is large enough.

In conclusion, a word may be said concerning other applications of the electric reciprocating engine. The Edison Co. announces that it is being adapted for stone dressing and surfacing machines and coal cutters and mining pumps. Riveting and calking and other processes in the working and finishing of wood, stone and metals are also to be carried out by reciprocating tools working on this system.

Although the rotary electric motor is the familiar type, the mode of operation of the reciprocating electric motor is much the simpler and more easily explained. It depends on the fact that a soft iron rod thrust into the center of a hollow cylindrical coil of wire through which an electrical current is passing will have a magnetic force exerted on it by the coil, tending to draw its center to the center of the coil. This action ceases the instant the current stops flowing, hence, by placing two or more of these coils end to end, and passing a current through them alternately, a reciprocating motion may be given to an iron plunger passing through their centers. That the force thus exerted may be a powerful one, its application to a successful rock drill gives excellent testimony.

CORRESPONDENCE.

Railway Traffic at Clapham Junction, London, and Broad Street Station, Philadelphia.

PHILADELPHIA, PA., May 6, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I note on page 403 of your issue of April 25 a sketch of the railway tracks at Clapham Junction, London, where the London & Southwestern and London, Brighton & South Coast railways cross. In speaking with an English engineer a few days ago he remarked that the movements of empty cars or engines were given as trains. I would be interested to know whether this is so in the statement giving 1,200 trains passing this junction every 24 hours. If this is their method of reporting trains it might be of interest to your readers to know that at the 17th St. tower of the Pennsylvania Railroad at Broad Street Station, Philadelphia, the number of movements in 24 hours, by record kept in May, 1850, was 1,734, an average of 72¼ movements per hour for 24 hours. The highest in one hour was 134 movements, being nearly 2¼ per minute; or, approximately, one movement in 27 seconds. At that date the station was operated with nine tracks at the terminal and three tracks leading to it. As a matter of course, this differs very much from the Clapham Junction—one being a terminal station, and the other simply a junction where trains pass, as I understand it.

JOS. T. RICHARDS,
Assistant Chief Engineer, Pennsylvania R. R.

[We cannot say authoritatively whether empty cars or engines are included in the total number of trains at Clapham Junction, but it appears probable that empty trains are included. As stated in our issue of Dec. 20, 1890, the total number of trains arriving at and departing from the Waterloo terminus of the London & Southwestern Ry., which is one of the roads using this junction, is from 700 to 800 between 7 A. M. and 11 P. M.—ED. ENG. NEWS.]

A Criticism of a Criticism.

NEW YORK, May 12, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of May 9 you find fault with my article on "Ice-Making and Machine Refrigeration" in the May *Popular Science Monthly* because it does not contain details of interest to engineers. Permit me to say that the article was not written for engineers, and that to nine-tenths of the readers of the *Monthly* such details would have been useless and tiresome. To users of ice—householders, hotel and restaurant keepers, marketmen, confectioners, etc.—my article, I am confident, is quite satisfactory. Engineers do not look to a professedly "popular" magazine for "definite facts as to cost and efficiency," but to technical journals like yours. You charge me with omitting these points simply to save myself trouble, but I assure you that it cost me considerable trouble to keep out of the article the many facts—historical, chemical and mechanical—which flowed in upon me while I was gathering my material, and which I did not deem germane to the purpose of my paper.

FREDERIK A. FERNALD.

[It has always seemed to us that MARK TWAIN set the true standard in regard to popular articles in

his "Innocents Abroad"—to avoid giving information as much as possible, but if "information would ooze out of him" to "let her go," and not struggle against this natural weakness, as our correspondent declares himself to have done. "Milk for babes," of course, is a thing to be kept in mind in writing for a miscellaneous public; but we think very few readers would have deemed a fact or two as to the actual and comparative cost of refrigerating by natural or machine ice, for example, inappropriate or unwelcome, or beyond their absorbing capacity. Moreover, the article was written for a professedly "popular *science*," and not merely "popular," magazine.—ED. ENG. NEWS.]

A Sample of Engineering Legislation.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I send you by mail to-day a copy of House Bill No. 818, legislature of Pennsylvania, which is, I think, a fair sample of average engineering legislation. I would like to call your attention particularly to the method of conducting examinations for inspector, mine foreman and superintendent, and also qualification of members of examining boards and candidates for examination.

Art. X requires *no educational qualification whatever* for members of inspectors' examining board. The questions and answers, with the rating, must be made public property.

Art. XV requires the miner and operator on the examining board for mine foreman and superintendent to hold a certificate as mine foreman and superintendent, and does not allow the candidate even to know why he is granted or refused a certificate; a very strange distinction.

Art. XV also require candidates for examination for superintendent to have been five years in and about the mines of Pennsylvania. It is openly asserted by the inspectors that this will "knock out" the graduate engineer superintendents, who are "cordially" hated by the inspectors.

Art. XV also provides for the granting of "time certificates" to mine foremen, but not to the superintendent, who must pass an examination in order to hold his present position; another unjust distinction.

I shall be very much pleased if you will publish any comments on this bill that you may think appropriate, whether favorable to the bill or otherwise.

MINE SUPERINTENDENT.

[It is hardly worth while for us to "comment" on such provisions as those noted, otherwise than to say that it is getting pretty late in the day to attempt to "knock out" graduate engineer superintendents, who are alone permitted to hold such offices in most other civilized countries, and who are quite sure not to stay "knocked out" very long.—ED. ENG. NEWS.]

Advancement of the Profession of the Civil Engineer.

KANSAS CITY, Mo., April 20, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: While reading the article in last week's issue of ENGINEERING NEWS entitled, "On the Advancement of the Profession of the Civil Engineer," I was surprised to see the following statement: "The President of the Kansas City Board of Public Works is ex-officio the City Engineer and must be a Civil Engineer." In correction of the above I quote the section of the City Charter providing for the appointment of the Board of Public Works. It is as follows, Art. VI, Sec. I: "There is hereby established within the city an executive department to be known as the Board of Public Works, to consist of the President of the Upper House of the Common Council, who shall be ex-officio President of the Board, and three persons, freeholders and electors of said city, who shall be appointed by the Mayor and confirmed by the Upper House of the Common Council in the same manner as other appointive officers of the city are appointed and confirmed."

The present President of the Board, Mr. J. S. CANNON, is not a civil engineer in any sense of the word. He is a politician and probably has a politician's knowledge of civil engineering.

Very truly yours,

A. E. F.

Notes and Queries.

A. H. D. writes: "We are troubled here (at Augusta, Ga.) with the overflow of the river, and among other plans for our protection is the one of impounding the waters above. Can you refer me to any precedent, any books, or authorities on the subject, or any engineer who has had charge of or planned a similar undertaking? Can you refer me to a locality where this plan of protection is now successfully operating?" With the exception of small streams on which especially favorable reservoir sites exist, the storage reservoir plan of preventing damage by floods is not considered feasible. See report on floods in the Susquehanna River, ENGINEERING NEWS, Aug. 23, 1884; Nov. 14, 1885; Feb. 14, 1891.

The Electrical Transmission and Conversion of Energy for Mining Operations.

(*Continued from p. 471.*)

THE ELECTRIC DIAMOND DRILL.

Another drill of great value to the mining engineer is the diamond drill. The Edison General Electric Company have, during the past thirty days, put upon the market an electric diamond drill which they have been developing for the past two years. The drill is the invention of I. E. STOREY, of Denver. It presents a great many advantages over the diamond drills heretofore used, as will be evident from the following description:

The drill weighs complete 239 lbs. The average power consumed is about 1¾ HP.; and with this expenditure of power the drill will bore a hole of 1¼ ins. diameter in hard rock at the rate of 2 ins. per minute, taking out a core of ¾ in. The drill rod is rotated at the rate of 400 revolutions per minute without any load; and when drilling at full load the speed is practically the same. The drill rod is geared by a single set of gears to an electric motor, which revolves at 1,600 revolutions under conditions of full load. The motor has four poles, and the keeper joining the poles is in the shape of a surrounding cylindrical shell, which thoroughly protects all the parts of the motor and other parts of the machine. Upon the drill rod is placed a rotary pump which supplies the drill with the necessary water.

In using the diamond drill the following points are of great importance:

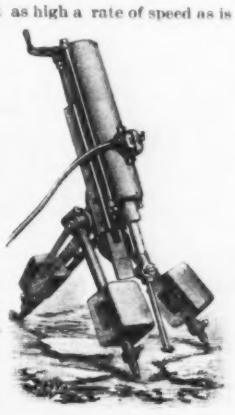
1. The speed should be uniform and automatically controlled very closely, so that removing the load quickly will not permit the drill to run away.

2. The drill should be extremely steady, as any material vibration transmitted by the drill rod to the diamond points is disastrous to them.

3. The drill should run at as high a rate of speed as is consistent with smooth drilling and a proper supply of water.

4. The drill should be as light and compact as is consistent with the requisite strength.

5. The drill should be capable of being readily and rapidly moved considerable distances and put into operation again with the least loss of time.



The Edison Electric Percussion Drill, Mounted on Tripod.

Up to the present time, diamond drills have been operated by reciprocating engines fastened upon the same frame as the drill rod, and connected to it by suitable gearing. The engine usually has two cylinders of the oscillating type to reduce the vibration as much as possible and eliminate the dead points. With these small engines it is practically impossible to get automatically the close regulation of speed which is desirable. Hence the speed is governed entirely by hand throttling, and the engines cannot be run at very high speed because of the vibration they would produce and because of the rapid wear of such engines at high speed. It therefore becomes necessary to drive the drill rod by gearing, which is oftentimes objectionably large, and would become even more so if the higher speed of the drill rod, which is desirable, were attempted. The space occupied by the drilling machine is quite large on account of the engine, gears, etc. This is a great objection when operating in tunnels, shafts and other contracted places.

With the electric drill the motion is free from any jar, as there are no reciprocating parts; and the speed can be fixed at any point and made absolutely constant under any condition of loading up to the full power of the motor. The speed of the drill rod can be increased up to several thousand revolutions per minute, if desired, and for any speed above 1,600 revolutions per minute gears are discarded and the motor is attached directly to the drill rod. The weight of the electric diamond drill is, for the same power, much less than that of the steam diamond drill, and the space occupied is in a direct line with the hole and is extremely small in amount.

The drill can be operated from any existing electric light circuit; and the current for it can be carried a distance of two miles from the source of power by wires of size No. 10 B. W. G. or about ⅛ in. diameter. The drill can be carried wherever a man can carry 35 lbs., which is the weight of the heaviest single piece; and it can therefore be set up and operated in the most inaccessible places.

It will be evident that for prospecting work, where a certain territory is to be explored, this drill is particularly adapted. Starting from a convenient and economical source of power, we can, if desirable, lay our wires along the surface of the ground and in a very few hours can be operating our drills miles away. We can then reel up our wire and lay it again in an exactly opposite direction, and again be in operation at a point perhaps 5 or 10 miles distant in the course of a few hours more. In laying the wire, a couple of horses yoked abreast and carrying a reel are all that is necessary. For operating at a distance of 1 mile in any direction the diameter of the wire necessary is but ⅛ in. and the total weight of the wire only 340 lbs.

The facility with which prospecting and also drilling for permanent works, such as mines and quarries can be done with this drill, will no doubt lead to its rapid and general use. There is every reason to expect that with the electric diamond drill the speed of rotation of the drill can be very greatly increased, with a consequent increase in the rate of drilling which will be of the greatest practical importance.

AN ELECTRIC DRILL FOR METAL WORK.

The Edison General Electric Co. have a third kind of drill, which is a rotary high speed drill, having a solid steel bit. This drill is used for drilling coal and similar comparatively soft materials and also for drilling metals, where it will have an extensive use in the construction of steel ships, and bridges and similar work in shop or field where the drill has to be taken to the work rather than the reverse. With the three drills which I have described, the Edison Company is now able to do any class of drilling desired, and these drills are likely to play an important part in the future of mining engineering.

OTHER APPLICATIONS OF ELECTRICITY TO MINING.

The electric mine locomotive, and the hoists, pumps ventilating fans, crushers, stamps, etc., operated by electricity, are instances of the application of electricity to mining which have already proved themselves entirely successful. The under-cutting of coal by electricity is an important field in which the Edison Co. has made great strides, the machines being of two entirely distinct types, in order to properly comply with the conditions met with in practice in different mines.

The electric refining of metals, especially of copper, is an extremely interesting subject to the mining engineer. The Edison Co. has established the majority of the plants of this nature in the United States, and I need only say that the results are highly economical and most satisfactory in every way.

The electrical transmission and conversion of energy at great distances is destined to come up in nearly every mining problem in the future. Mines are usually in a mountainous country, and it is seldom that a water-power cannot be found within a few miles of a mine. The mining engineer in the immediate future will utilize this water power, convert its energy into electric energy, in which shape he will transmit it to the distant mine, when it will be again converted into the various forms of energy which he may have occasion to require. Among the applications will be the following:

1. The lighting of the mines and the buildings and grounds by arc and incandescent lamps.

2. The operation of any machinery in the mill, such as crushers, stamps, etc.

3. The operation of the drills, the hoists, the pumps and the ventilating fans.

4. The operation of an electric tramway in the mine.

5. The heating of the buildings when fuel is scarce.

6. The refining of copper and the recovery of gold and silver in certain cases.

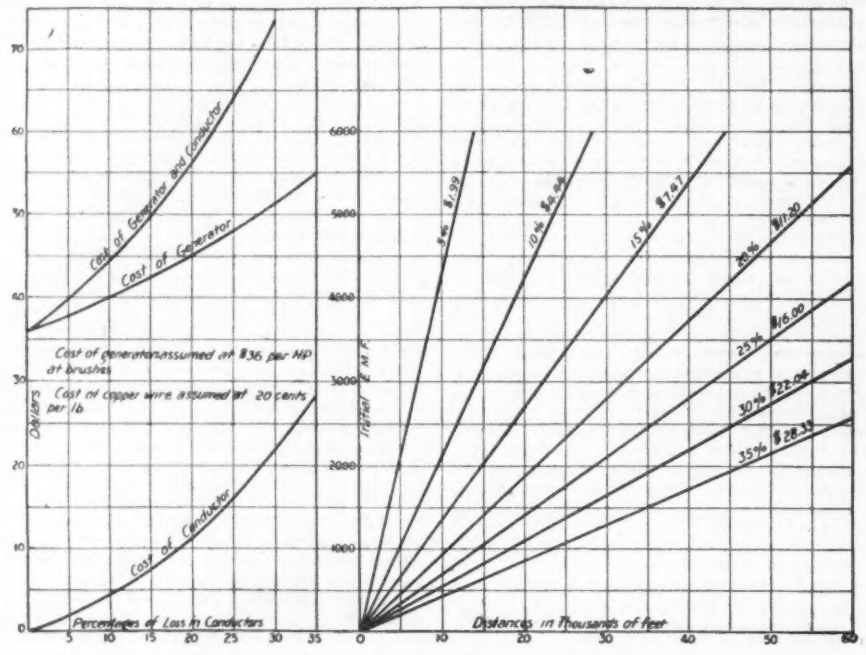
7. The concentration of magnetic ores in certain cases, such as iron, nickel, etc.

In order to give you a commercial idea of such a plant as is likely to be used in mining operation in the immediate future, I will suppose a case and give you an estimate of the first cost and operating expenses of such a plant. Let us suppose that we have a mine where we have to operate the following plant: 360 incandescent lamps of 16 c. p. each; 10 arc lights; 1 hoist requiring 30 HP.; 1 pump requiring 20 HP.; 6 percussion drills for drilling 1½-in. holes at the rate of 3 ins. per minute; 2 rotary diamond drills, 1¼-in. hole, ¾-in. core, rate 2 ins. per minute; 1 mine locomotive, 10 HP.; milling machinery requiring 30 HP.; heating requiring 10 HP.

The total power required for the above will be 180 HP. delivered by the main motors. Suppose that at a distance of three miles there is a good water power, which can be developed and equipped with water wheels to produce 300 HP. by an expenditure of $15,000. In considering transmission of the power by electricity, we must first determine what loss we shall sustain in transmission, and then we must determine what electrical pressure we will operate with.

In designing such a plant there are certain fixed laws governing the conditions of highest economy and minimum first cost; and some years ago I investigated these questions and deduced formulas expressing these laws. These formulas are given herewith in tabular form. I have also expressed the laws governing the conditions of minimum initial cost graphically in the accompanying diagrams.

It may be interesting to note here, in passing, a fact which you will observe by examining the formulas given, namely: If we pay proper attention to the laws governing the highest efficiency and the least first cost, the cost of the conductors for the plant will depend solely upon the initial E. M. F. and the distance. Thus under practical conditions to-day, if we are to operate with 2,000 volts E. M. F. at a distance of 5 miles, the minimum first cost would be realized when we operate with a loss of 20% in conductors. The cost of copper (at 20 cts. per lb.) for each



CURVES SHOWING LEAST TOTAL COST OF ELECTRIC GENERATOR PLUS CONDUCTOR.

DIAGRAM FOR DETERMINING COST OF ELECTRIC CONDUCTORS PER HP. (746 WATTS) AT MOTOR TERMINALS FOR THE MINIMUM FIRST COST OF PLANT.

Formulas for Electrical Devices in Multiple-Arc.

E = E. M. F. of generator in volts.
e = " " device " "
C = Current in amperes.
$c.\ p.$ = Candle power of lamps at normal E. M. F.
$T\ c.\ p.$ = Total candle power of lamps
$C.\ h.\ p.$ = Candle power per electrical horse power at normal E. M. F.
M = Area of cross-section of wire in circular mills.
D = Mean distance current is transmitted one way.
V = Loss of E. M. F. in conductor (in volts).
$\$$ = Cost in dollars.
L = Cost of copper per pound in cents.
W = Watts per candle power.
T = Weight of wire in pounds.
P = Efficiency of device.
p = Percentage loss in conductors.
G = Cost of generator per HP. delivered by conductor.

Conductors, as Determined by Losses therein.

		Size.	Weight.	Cost.
Incandescent lamps. — Two-wire system.	General cases.	$M = \frac{T\,c.\,p. \times D \times 16{,}000}{e \times V \times C.\,h.\,p}$	$T = \frac{D^2 \times T\,c.\,p.}{V \times e \times C.\,h.\,p. \times 1{,}000}$	$\$ = \frac{D^2 \times T\,c.\,p. \times L}{V \times e \times C.\,h.\,p. \times 1{,}000}$
		$M = \frac{T\,c.\,p. \times D \times W \times 21.5}{e \times V}$	$T = \frac{D^2 \times W \times T\,c.\,p.}{V \times e \times 746{,}000}$	$\$ = \frac{D^2 \times W \times T\,c.\,p. \times L}{V \times e \times 746{,}000}$
	For 100-volt lamps, 4.66 watts per c. p.	$M = \frac{T\,c.\,p. \times D}{V}$	$T = \frac{D^2 \times T\,c.\,p.}{V \times 16{,}000{,}000}$	$\$ = \frac{D^2 \times T\,c.\,p. \times L}{V \times 16{,}000{,}000}$
	For 110-volt 3.1-watt lamps	$M = \frac{T\,c.\,p. \times D \times 2}{3 \times V}$	$T = \frac{D^2 \times T\,c.\,p.}{V \times 24{,}000{,}000}$	$\$ = \frac{D^2 \times T\,c.\,p. \times L}{V \times 24{,}000{,}000}$
Incandescent lamps. — Three-wire system.	General cases.	¼ of corresponding two-wire case	⅛ of corresponding two-wire case	⅛ of corresponding two-wire case.
	For 100-volt 4.66-watt lamps			
	For 110-volt 3.1-watt lamps			
For any case		$M = \frac{C \times D \times 21.5}{V}$	$T = \frac{C \times D^2}{V \times 7{,}460}$	$\$ = \frac{C \times D^2 \times L}{V \times 746{,}000}$
For power at motor pulley		$M = \frac{D \times \text{HP.} \times 1{,}600}{V \times e \times P}$	$T = \frac{D^2 \times \text{HP.}}{V \times e \times 10 \times P}$	$\$ = \frac{D^2 \times \text{HP.} \times L}{V \times e \times 1{,}000 \times P}$
For minimum total initial cost of plant				$\frac{G \times E \times V}{(E-V)^2} = \frac{G \times p \times 100}{(100-p)^2}$ = dollars per HP. delivered by conductor.
Cost of generators for minimum total initial cost of plant				$\frac{100\,G}{100-p}$ = dollars per HP. delivered by conductor.

horse power delivered at the motor brushes under these conditions would be $7.47. This simple but invariable law, which is embodied in the formulas given herewith, you will find of great assistance to you in considering questions of electrical transmission.

You will also notice that the formulas show that for any given percentage of loss the electrical pressure to be employed will vary directly with the distance. Thus, for 20% loss, the cost of copper being $11.20 per HP. delivered at motor brushes, the E. M. F. necessary for transmission,

Conductors, as Determined by Safe Heating.

Bare copper wire	15° Cent.	$M = C^{4/3} \times 200$
	35° Cent.	$M = C^{4/3} \times 170$
	45° Cent.	$M = C^{4/3} \times 100$
Average insulated copper wire	15° Cent.	$M = C^{4/3} \times 150$
	35° Cent.	$M = C^{4/3} \times 100$
Bare iron wire	45° Cent.	$M = C^{4/3} \times 328$
Bare German silver wire	45° Cent.	$M = C^{4/3} \times 608$

16,000 ft. will be 15,900 volts; at 32,000 ft. we should use 3,000 volts, and at 8,000 ft. 750 volts.

In order to secure the 160 HP. necessary at our various devices in and about the mine, we must deliver 200 HP. to our main motor in the form of electric energy in the conductor at the brushes of the motor. With 25% loss in conductors, this will mean 266 HP. at the generator brushes, or 300 HP. delivered by the water wheels.

For the sake of reliability and economy we will use two generators instead of one, each being of 133 HP. At the mine there will be two main motors of 90 HP. each, wound for 900 volts and 83 amperes, producing a total of 180 HP., which will drive the drill generator of 17 HP. and a generator of 250 volts and 300 amperes for operating the incandescent lamps, the arc lamps, the locomotive, the hoist, the pump, the diamond drills and the heaters. The main motors will also supply the milling machinery with the necessary 30 HP.

By formulas in the table we find that to transmit 180 HP. 3 miles with 25% loss and an initial pressure of 1,200 volts there will be required a wire having a circular millage of 190,000 circular mils.; that is having a diameter of $\frac{436}{1000}$-in. We find by other formulas in the table that the copper will weigh 20,000 lbs. and will cost $1,000, which results check each other and prove the accuracy of the calculation.

We are now able to make an estimate of cost of the plant for transmitting 180 HP. a distance of 3 miles with a loss of 25% in conductors, and of the plant at the mine before specified:

Developing original water-power and installing water wheels of 300 HP	$15,000
2 generators, 100 kilowatts each (1,200 volts 83 amperes each), at $36 per kilowatt	7,200
2 motors, 75 kilowatts each (900 volts 83 amperes), at $36 per kilowatt	5,460
Copper, 32,000 ft. No. 000 B. W. G	4,000
1 six-drill generator	2,000
1 generator of 250 volts 300 amperes (75 kilowatts, at $36)	2,700
6 electric percussion drills	3,300
2 electric diamond drills	1,100
360 incandescent lamps and appliances	360
10 arc lamps	220
1 30-kilowatt hoist	2,255
1 20 kilowatt pump	1,595
1 10-kilowatt locomotive	1,815
Heaters, 10-kilowatt	600
Conductors for all secondary transmissions	1,000
Labor of installation	3,000
Poles	455
Freight, cartage and sundry expenses	1,000
Total	$53,000

The operating expenses of such a plant will be those mainly due to the wages of two men, one at the water-power and one at the mine.

A fair allowance for depreciation and repairs will be 5% per annum of the first cost.

The operating expenses will therefore be about as follows:

1 First operator	$900	per year.
1 Second operator	600	" "
Depreciation and repairs, 5% on $53,000	2,650	" "
Sundry incidental expenses	250	" "
	$4,400	

The production of the same power by steam, when coal is $2 per ton and labor such that an engineer's wages are $2 per day, would be not less than double this amount; and in many instances where water and fuel suitable for the generation of steam are difficult to obtain, such a plant would represent a saving of its entire first cost every year.

Notes on English Railways.

(*Continued from p. 439.*)

NORTH LONDON RAILWAY.

This line is, as its name implies, a London local line. Its total length is 12 miles, but it carries a very heavy passenger traffic morning and evening between the city and nothern suburbs. It has also a large freight traffic, as it forms a connection between several of the main lines and the London docks. Its own main line is from Camden Town and Chalk Farm, where are the freight yards of the London & Northwestern Ry., to the docks; but the

heaviest traffic is over the short line which branches from the through line at Dalston and runs to Broad St. in the city, where are a large passenger terminal station and freight yard. The company's trains run over numerous connecting lines. At a meeting of the company in February it was stated that 1,500 trains were run per day, and controlled by 545 signals on the main line. The number of passengers during the last half of 1890 was 20,860,915.

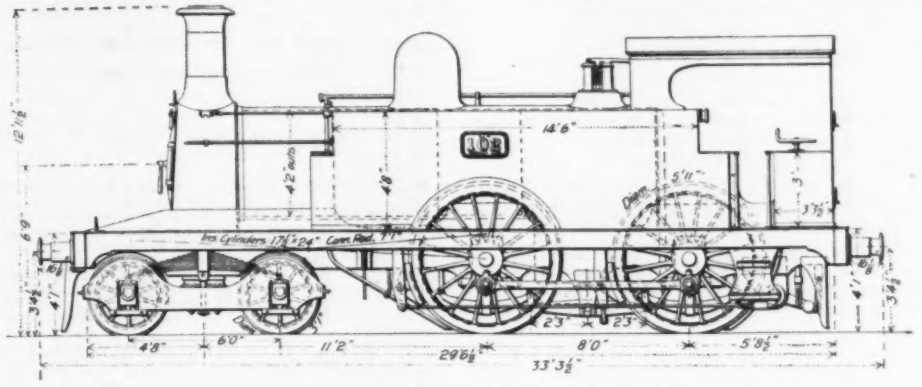


FIG. 55. INSIDE CYLINDER PASSENGER ENGINE.

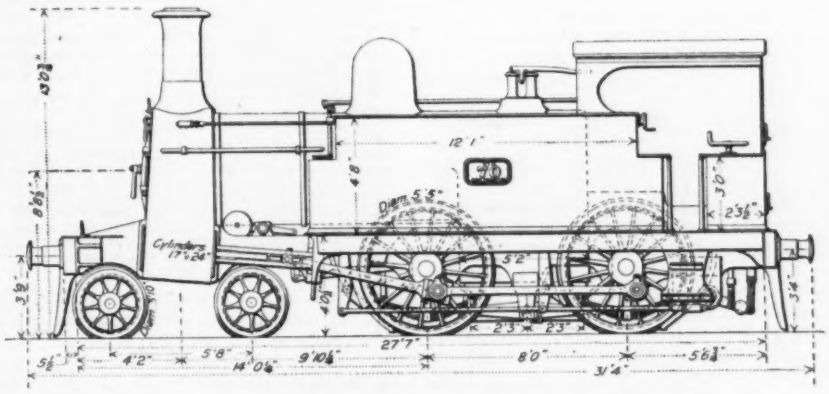


FIG. 56. OUTSIDE CYLINDER PASSENGER ENGINE.

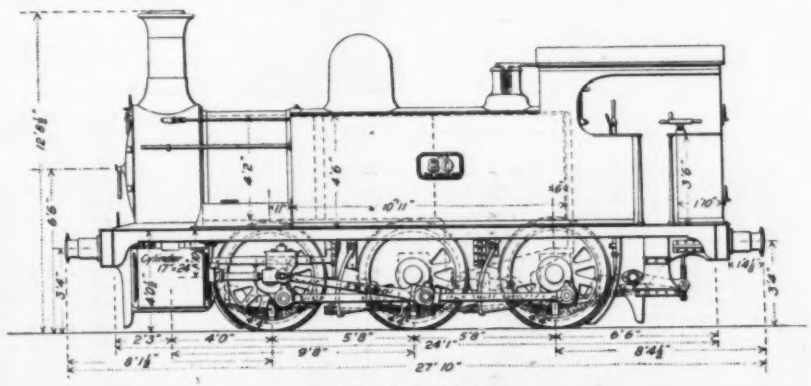


Fig. 57. Freight Engine.

LOCOMOTIVES OF THE NORTH LONDON RAILWAY; ENGLAND.

Track.—There are four tracks from Broad St. to Camden Town, two being for local trains stopping at every station, and two for express and freight trains. During the slack hours of the day some freight trains are run on the local tracks. Heavy bull head rails are used, carried in chairs secured to the ties by four fastenings to each chair, with the wooden keys on the outer side of the rail. The outer jaw of the chair is inclined toward the rail, and has a lip on the inner edge of the top, to prevent the key from rising out of place. The joints are suspended, sometimes even and sometimes broken, spliced by deep splice bars and four bolts, with the nuts on the inner side of the rail. The inner bar is grooved to hold the boltheads. In some cases the splice bars are bent round under the lower head of the rail, in the manner shown in Fig. 37, on p. 381 and Fig. 59; in other cases the lower part projects vertically below the rail. Where the splice bars have been worn at the bearing of the ends of the rail heads a small piece of iron is sometimes inserted between the top of the bar and the under side of the rail heads to take up this wear. There are 12 ties to a rail length. The ballast is of gravel, covering the ties, and sloped down from the middle of the outer side of the web of the rail so as to leave a portion of the ends of the ties exposed. Where the track is laid with broken joints there is a cross drain in the ballast under every joint, and where laid with square joints there is a drain at the joints and middle of the rails. On bridges the ordinary track with crossties and ballast is sometimes carried across the floor; and sometimes the chairs are fastened to longitudinal timbers and no ballast is laid on the buckle-plate floors. Some of the Webb steel ties are laid between Dalston Junction and Hackney. The terminal station at Broad St. has a wide end platform, with narrow platforms running out between the tracks. There is a pit between the rails of each track, the chairs being carried on heavy creosoted timbers on the brick sidewalls of the pit, and secured by 2 spikes and 2 trenails. The chairs used in the station have a special form of wooden key, held in place by an iron cap on the top of the outer jaw of the chair. At the end of each track are hydraulic buffers of the Webb type, described in ENGINEERING NEWS, Jan. 24. This station is now being rearranged to accommodate more tracks. From Broad St. the line runs on a brick viaduct nearly to the junction with the through line at Dalston, when it descends below the street level by a grade of 1 in 60 (1.66%). A considerable portion of the other part of the line is also carried on brick viaducts. The streets are crossed by plate-girder through bridges. At Camden Town there is a bridge with girders high enough to carry a corrugated iron roof. The switchrods are of gas-pipe. One end of each length of pipe is expanded for a length of about 8 ins. to a diameter large enough to admit the end of the next length, and 2 cotters effect the coupling. The rails are very brutally treated by the action of the chain brakes, which slide the wheels and cause showers of sparks at nearly every stoppage. The ballast at stations is strewn just along the rails with slivers and particles of steel ground off by the wheels. At the freight yard at Broad St. is a hydraulic elevator for taking coal and freight cars down to the freight station on the street level. The cars are handled by a turntable and hydraulic capstans.

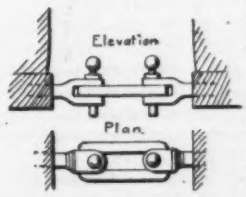


Fig. 58. Car Coupling; North London Ry., England.

Locomotives.—The engines of this road are all tank engines, of three types, as shown in Figs. 55, 56 and 57. For freight service the engines have horizontal outside cylinders and six wheels, all coupled. The passenger engines are of the eight-wheel type, some with inside cylinders and outside truck frames, and others with outside cylinders and inside truck frames. The cylinders are inclined. The driving springs are connected by equalizing levers. The footplate is roomy, and fairly well protected by an iron cab. The domes are large, and the safety valves are of the Ramsbottom duplex type. The older engines had the sandbox on top of the boiler, but the later ones have a sandbox on each side, at the end of the tank. They have a deep, full-sounding exhaust. The whistles, as on most English engines, emit an ear-piercing screach which is very trying to the nerves, especially at close quarters. The engines are fitted with hand brakes on the driving-wheels, which are applied at every stop. The driving-wheel brake shoes are of wood. The freight engines are ugly, but the passenger engines are compact and serviceable looking, and are well designed and well built. The outside cylinder engines were formerly painted a light green and the inside cylinder engines black, but they are now all painted black, with a very little red striping and brasswork. The coupling rods are red. The engines are built at the company's works at Bow, one of the manufacturing districts in the northeast of London. Mr. J. C. PARK is the locomotive superintendent, and in reply to an inquiry as to the relative merits of the outside and inside cylinder engines he stated that besides being cheaper to build there is with the former an economy in fuel of about 2 lbs. per train mile. The dimensions of the three classes of engines are as follows:

	Ins. cyl. Pass. Fig. 55.	Out. cyl. Pass. Fig. 56.	Out cyl. Freight. Fig. 57.
Cylinders	17½ × 24 ins.	17 × 24 ins.	17 × 24 ins.
" inclination	1 in 18	1 in 12	Hor.
Diam. driv.-wheels	5 ft. 11 ins.	5 ft. 5 ins.	4 ft. 4 in.
" truck "	3 ft. 1 in.	2 ft. 10 ins.	....
" boiler (out).	4 ft. 2 ins.	4 ft. 2 ins.	4 ft. 2 ins.
Boiler pressure, lbs.	160	160	160
Tubes, number	192	186	192
" diameter	1¾ ins.	1¾ ins.	1¾ ins.
" length	....	10 ft. ⅞ in.	9 ft. 11½ ins.
Heat. surf., tubes, sq. ft.	1,050.72	860	875.85
" firebox, sq. ft.	91	91	81
" total, sq. ft.	1,141.72	951	956.85
Grate area, sq. ft.	16.62	16.62	16.33
Driving-wheel base	8 ft.	8 ft.	11 ft. 4 ins.
Truck " "	6 ft.	5 ft. 8 ins.	....
Total " "	22 ft. 2 ins.	20 ft. 8¼ ins.	11 ft. 4 ins.
Weight on truck or leading wheels, lbs.	31,360	30,156	32,788
" driv.-wheels	35,840	35,500	32,816
" trail. "	33,600	37,408	32,788
" total	100,800	103,124	98,392
Tank, U. S. galls.	1,320	1. 20	1,147
Coal space, lbs.	2,800	2,800	2,800

Rolling Stock.—All the passenger cars of this road are short four wheel cars, very similar to the one illustrated on p. 273. They are permanently coupled up into trains by the form of coupling shown in Fig. 58, being separated only for repairs, etc.

Each car has short stroke spring buffers at one end and wearing plates at the other. Mansell wheels are used. The trains are lighted by coal gas, which is stored in a vertical collapsible "bellows" reservoir in each baggage car. A pipe runs along the top of the outside of the roof of each car, and is fitted with a tap at each end and flexible connections with the other cars. A short branch pipe projects down into the clear-glass globe of the lamp in the roof of each compartment, the branch having a tap inside the lamp, and the end being turned up and fitted with a burner. The light is very poor and flickering. At the side of each track in the Broad St. terminus, near where the front end of the train stops, are two or three standpipes, like water hydrants, with large rubber hose attached. When a train stops the engine is uncoupled and run ahead a little way. A porter then couples up the nearest hose to a pipe at the end of the car, and opens the valves on this pipe and the standpipe. Heavy weights are placed on the top of the "bellows" to give the necessary pressure in the train pipe. When the lamps are to be lighted a man walks along the roofs of the cars, opening the tops of the lamp covers, and, then returning, lights each one by lowering over the burner a hand lamp with a hole in the bottom, and then closes the top. The gas is used also for the tail and side lights, the latter showing a white light along the train and a red light behind. The Clark & Webb chain brake is used, and, as already noted, it is very hard on the rails, owing to the frequent sliding of the wheels. The stops are made rather slowly, and it is strange that a line with so heavy a traffic should continue to use a brake of this kind. The first-class cars have 4 compartments, seating 8 passengers each. They are upholstered in dark-blue cloth, and have arm rests and padded arm straps. Above the back padding the partitions are covered with a sort of American cloth, white with a blue pattern. The floor is carpeted. The smoking compartments are upholstered in dark red or brown leather.

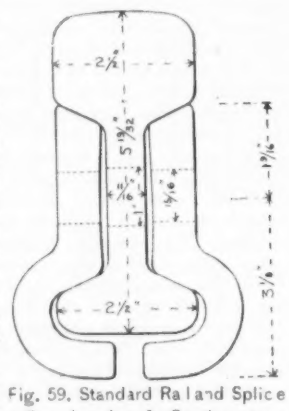


Fig. 59. Standard Rail and Splice Bar: London & Southwestern Railway, England.

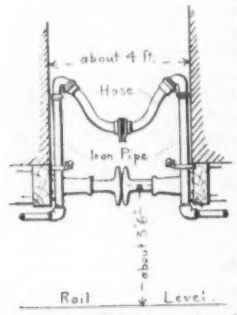


Fig. 60. English style of brake pipe coupling.

The second class cars have 5 compartments, seating 10 passengers each. They are 7 ft. 4 ins. wide inside. Some of them have bare floors; others have carpets or cocoanut mats. The seats and backs are upholstered in a yellowish brown carpet cloth. The roof is of plain boards, painted white. The partitions above the seat backs are painted and grained in imitation sycamore, and the doors are of polished wood, with a large figure 2 in yellow on the panel. A rack for light hand baggage is fitted along each partition. Some of the smoking compartments have only low backs to the seats. The third class cars have 5 compartments, seating 10 passengers each. They have no partitions, but only shoulder-high backs to the seats. The seats are of bare wood. Between the doors is sometimes one and sometimes two windows. At each end of the train is a guard's van and baggage compartment, with the gas reservoir at the inner end. The rear portion of the roof is raised, forming a hood, with windows all round, and having a high seat inside the car, so that when the train is running the conductors can see along the train, and have a brake wheel close at hand. The outside of the cars is of natural wood, rubbed down and varnished, and lettered in gilt. The rear ends of the baggage cars are painted red. The doors have sashes and two horizontal bars are placed across the window to prevent passengers from putting their heads out, on account of the closeness of the tracks at some places. The windows next the seats are fixed, and (except in the third class) are fitted with spring blinds, which on most cars must be either quite up or quite down. The doors have spring latches, generally with inside and outside handles, and have finger guards on the inside. The first and second class cars have a lamp in the roof of each compartment, but the third-class cars, which are without partitions, have two or three lamps. There are two guards to each train, who change cars at the end of the run, retaining their respective positions as head and rear guard. At each stop the guards alight, call the name of the station and close doors left open by passengers near the end of the train. Other open doors are slammed by the station porters as the train starts. In starting, the rear guard sounds a whistle when he sees all clear at his end; then the head guard sounds his whistle, signaling the engine driver to go ahead.

The standard passenger train consists of 10 cars and 2 baggage cars, and weighs empty about 104 tons. The first-class cars are at the middle of the train, with the second-class at one end and the third-class at the other end. The trains are nearly empty during the middle of the day, but owing to the make-up and the number of classes it is not practicable to cut cars off, as it would involve too much time and labor in switching. The speed is rather slow, except on the express trains, which make but few stops. The arrangement of the standard train is as follows, the unusual proportion of second-class accommodation being provided on account of the large number of second-class season ticket holders:

	Passengers.
1st car, conductor, baggage and gas	—
2d car, third-class	50
3d car, "	50
4th car, "	50
5th car, " (smoking)	50
6th car, 3 second (30), 2 first (16), smoking	46
7th car, first-class	32
8th car, 2 first (16), 3 second (30), smoking	46
9 h car, second-class	50
10th car, "	50
11th car, "	50
12th car, conductor, baggage and gas	—
Totals: first, 64; second, 210; third, 200	474

LONDON & SOUTHWESTERN RAILWAY.

In our issue of April 18 we described and illustrated the track of this road. Mr. E. ANDREWS, Chief Engineer, writes us that since 1889 the type of track has been altered. The new type of rail is of bull-head section, as shown in Fig. 59, and weighs 87 lbs. per yd. The chairs weigh 46 lbs. each, and no nail is used to keep the wooden keys from working loose. The splice bars weigh 40 lbs. per pair.

This is one of the roads using the vacuum automatic brake, and the arrangement of the brake pipes and hose couplings at the ends of the cars is shown in Fig. 60. The hose for the vacuum brake is much larger than that used with the Westinghouse brake. To couple the brake hose the porter takes one in each hand and lifts them high enough to hook the bottom horns of the couplings together, and then by lowering them places the top horns in the slots. To uncouple, the pipes are simply lifted up, when the horns at the top will come out of the slots and the couplings will then separate. When uncoupled the end of the pipe is placed on the stop plug.

E. E. R. T.

(To be continued.)

Boiler Notes from the Manchester Steam Users' Association Report.

The report of the annual meeting of this society contains the following on the increase in the size and working pressure of boilers:

The size of boilers for years past has been on the increase. Some years since the standard diameter was 7 ft.; then it grew to 7 ft. 6 in., then to 8 ft., and more recently to 8 ft. 6 in.—that is to say, in boilers of the Lancashire type. A diameter of 8 ft. in the shell and 3 ft. 3 in. in the furnaces, with a length of 30 ft., has become almost a standard size for Lancashire boilers. Boilers of the multitubular marine type are of larger diameter still, and they are coming into very frequent use for stationary purposes, the diameters in those cases being as much as 11 or 12 ft.

The pressure of steam adopted is also rapidly rising. In the early days of the association a pressure of 60 lbs. was regarded as high. Pressures then rose to 75 lbs., and that was the standard for some time, after which they rose to 100 lbs., and for years past the association has always recommended its members when laying down new boilers not to have them made for a lower pressure. Boiler pressures however, did not remain at that point. They rose in some cases to 125 lbs., then to 150 lbs., then to 175 lbs., and have now risen to 200 lbs. We have several boilers guaranteed at 150 lbs., while one of our members has a multitubular marine boiler working at 190 lbs., and is laying down another to work at 200 lbs.

We are now having frequent inquiries for advice with regard to the construction of boilers for these high pressures, and it is felt to be a responsible duty to advise on this question. Water-tube boilers have been proposed to meet the difficulty, but the experience of the association has not been in favor of such boilers, and the opinion of our chief engineer is that there will be less trouble with boilers of the Lancashire type at a pressure of 200 lbs. per sq. in. than with any other at present in use. At the same time, it is considered to be a serious matter to jump up suddenly to so high a pressure. The boilers would have to be most carefully constructed, with special provision for strengthening the furnace tubes.

That many noted engineers abroad do not share this distrust of the water-tube boiler for high pressures is shown by a table kindly furnished us by the Babcock & Wilcox Co., showing that since April 13, 1886, their Glasgow house has sold 95 boilers to work at pressures above 175 lbs. The total horse power of these boilers was 14,212 HP. We publish some of the more prominent names in this table as follows:

PARTIAL LIST OF STEAM BOILERS BUILT FOR A WORKING PRESSURE ABOVE 175 LBS., SOLD BY THE BABCOCK & WILCOX CO., GLASGOW, SCOTLAND.

Job No.	Testing date	Name, trade and address.	Testing pressure.	No. of boilers.	Total HP.	Working pressure.
269	13- 4-86	John Dewrance & Co., engineers, London	350	1	10	200
233	8- 6-86	Compagnie Tramways du Departement du Nord, France	330	2	135	230
253	12- 8-86	Pneumatic Pulverising Co., London	300	1	40	200
303	29-12-86	The Cambrian Patent Fuel Co., Limited, Cardiff	350	1	92	250
308	7- 1-87	The British Pneumatic Pulverizing Co., London. *Second order*	300	1	40	200
352	13- 5-87	The Southwark & Vauxhall Water Co., Wandsworth, London	300	4	336	200
440	15-12-87	Compagnie des Tramways et Omnibus, Lyons, France	340	2	90	240
530	16- 3-89	La Espana Industrial de Matias Muntados, Barcelona	270	4	480	180
544	29- 3-88	Sulzer Frères, engineers, Winterthur, Switzerland	270	1	140	195
585	21- 8-89	Compagnie des Tramways et Omnibus de Lyons. *Second order*	330	1	70	228
619	29- 8-89	Tramways de la Seine, Courbevoie, France. *Third order*	330	3	156	240
653	30- 7-89	Elwell-Parker & Co., Limited, London	300	1	120	200
679	25- 6-89	Alexander Friedmann, engineer, Vienna	270	1	36	261
690	30- 8-89	Alexr. Turnbull & Co., engineers, Bishopbriggs, Glasgow	500	1	51	300
737	21- 5-89	The Electrical Construction Syndicate, Ltd., London	300	9	1,404	200
772	17- 8-89	Troller Frères, electricians, Lucerne, Switzerland	270	1	244	180
956	... ...	G. Luther, engineer, Braunschweig, Germany	285	2	384	180
1,022	... ...	Ontario School of Practical Science, Toronto, Canada	300	1	52	200
1,076	.....	James Simpson & Co., Ltd., engineers, Delhi, India	300	2	212	180
1,101	.....	Siemens & Halske, electricians, Charlottenburg, Berlin	240	3	660	180
1,108	.....	Ganz & Co., electricians, Buda-Pesth, Hungary	225	3	420	180
.....	.....	Jobs Nos. 463, 464, 470, 480, 512, 513, 661, 662, 663, 664, 741 and 742, ranging from February, 1888, to August, 1889, were for the London Electric Supply Corporation, Ltd., Deptford, and S. Z. de Ferranti, electrician, London. The testing and working pressures and the total boilers and HP. were	300	32	6,898	200

On general principles, the sectional or water-tube boiler, of which the Babcock and Wilcox is one of the best known types, seems much safer than the ordinary shell boiler, and is generally so regarded by American engineers. Of course, the higher the pressure employed, the more manifest is the need of employing the safest type of boiler. The good opinion of the sectional boiler for high pressures which is held by many prominent engineers abroad is well shown by the above table; and their opinion may well carry with it greater weight than the opinion of the rather conservative engineer of the Manchester Steam User's Association.

The report has the following very good matter on smoke prevention:

All new boilers made under the supervision of the Association have been fitted with ventilating fire doors,

affording ample provision for the admission of air above the bars for the combustion of the gases. Drawings of the split bridge and the inverted or hanging bridge have been supplied whenever requested, while in some cases an inspector has been sent to instruct the stokers in the art of firing, and this course has been attended with marked success. The system of alternate side firing, introduced by Mr. CHARLES WYE WILLIAMS, coupled with the introduction of a little air, either at the fire door or fire bridge or at both places simultaneously, will reduce smoke to a minimum and prevent its being any practical nuisance. It is most important in hand firing that the coal should not be thrown on in heavy charges and that the fires should be not roused with a rake, but that the watchword should be, fire regularly; fire little and often.

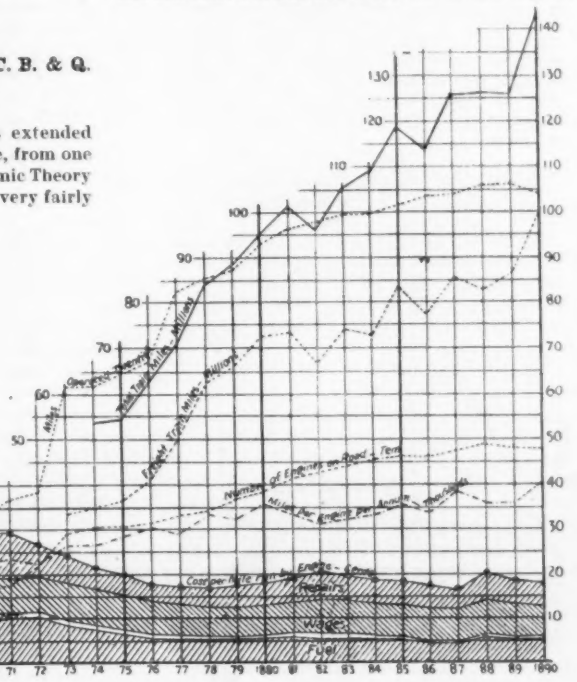
Some experiments have been made during the past year to determine the difference of temperature of the water in a boiler at the top and at the bottom when getting up steam. When the water at the bottom of the boiler reached 212° it was found in three cases that the steam at the top of the boiler had risen to over 70 lbs. pressure, corresponding to a temperature of 316°, and in two cases it had risen to above 80 lbs. pressure. In one case the difference of temperature found was 230°.

Locomotive Statistics for 25 Years, C. B. & Q. R. R.

The accompanying diagram, which is extended for 6 years more, up to the present date, from one which appears on page 157 of the "Economic Theory of the Location of Railways," illustrates very fairly the past and present tendency in regard to the management of American locomotives. Since 1884, when the former diagram terminated, it will be seen that the miles run per year per engine has continued to heavily increase, and is now no less than 40,717 miles per engine, against only 33,548 in 1884, 26,500 in 1874, and only 12,500 in 1868, at which last date C. B. & Q., practice was even lower in this respect than the present average of English practice, which is 17,000 to 18,000 miles. Wages have very slightly declined since 1884; repairs have very heavily declined 5.46 to 4.70 cts. per mile), waste and oil have declined somewhat (0.35 to 0.28 cts.) and fuel only has somewhat increased (5.34 to 5.72 cts.) which last is merely a result of the fact that the average freight-train load has very heavily increased. We are not able to show in this issue just how much it has increased, but shall do so later. It has much more than doubled in the last 20 years. In connection with the former diagram, the following comments were made in the volume above referred to, which, except as noted, are still applicable:

Alone of all the items, wages, it will be seen, have remained practically stationary. There was a slight tendency to decrease during the hard times of 1877-73, but they recovered later. The cost of fuel declined sharply after 1872, but since 1876 has been nearly uniform. Two possible causes for this are indicated on the diagram, both of which probably had their effect." One was the increase in miles operated, which probably gave better access to coal mines, but another, and, probably very important contributing cause, was the increase in miles run per engine per year, which likewise began simultaneously, and ceased to advance sharply after the cost of fuel ceased to decrease.

The course of cost of repairs is very instructive. It will be seen that the decrease has been enormous, and it is, doubtless, in great part due to natural and permanent causes, such as the decrease in cost of materials and better shop facilities But it needs but a brief glance at the line showing "Number of engines on road," in connection with the cost of repairs, to detect anyther explanation, of vast importance in its effect on operating expenses, which is too little remembered in studying maintenance charges, viz., the enormous and continuous infusion of "new blood" into the locomotive stock, giving at all times a very large number of new locomotives in the stock *in addition* to the proportion naturally required to replace old engines worn out. As new engines cost comparatively little for repairs, it is inevitable that this abnormal proportion of new engines should greatly affect the average cost of repairs, and it is very clear that it did so. The very small expense for repairs in 1875-79 was not wholly due to economies enforced by hard times, although no doubt largely so, but in great part to the fact that there was a greater proportion of new engines


Miles Run per Engine per Year
Cost per Mile in Cents
Number of Engines on Road
Fuel
Repairs
Waste
Wages
1866 67 68 69 1870 71 72 73 74 75 76 77 78 79 1880 81 82 83 84 85 86 87 88 89 1890

Locomotive Statistics for 25 Years, 1865--1890, Chicago, Burlington & Quincy R. R.

LOCOMOTIVE STATISTICS FOR 7 YEARS, 1884-1890, CHICAGO, BURLINGTON & QUINCY R. R.

		1884.	1885.	1886.	1887.	1888.	1889.	1890.
Miles operated		1,982	2,034	2,069	2,080	2,155	2,119	2,060
Thousands of train miles		10,886	11,861	11,416	12,551	12,513	12,573	14,3.0,039
Thousands of freight train miles		7,272	8 364	7,752	8,558	8,280	8,634	10,035,252
Number of engines on road		452	462	463	473	490	480	478
Miles run per engine		33,548	35,440	33,853	38,607	36,068	36,592	40,717
Cost per mile in cents.	Misel. mtl.	....	....	....	....	....	0.08	0.11
	Small stores	0.11	0.11	0.08	0.18	0.14	0.08	0.07
	Waste oil and tal.	0.35	0.28	0.21	0.18	0.27	0.23	0.28
	Fuel	5.34	5.25	4.47	4.60	6 02	5.91	5.72
	Wages	7.46	7.17	7.42	7.21	7.96	7.39	7.04
	Repairs	5.46	5.59	5.04	4.45	5.63	5.62	4.70
Total		18.72	18.50	17.22	16.52	20.02	19.31	17.92

in service than at any time before or since. Afterward the inevitable increase came about, in spite of heavy falls in the cost of much of the material used, due to improved processes of manufacture and cheaper transportation, and, should the continual additions of new stock cease, it is very certain that the increase must go still further [The additions of new stock have been small, however, while the decrease in repairs has been decided.] It is to be remembered also that these nominal "repairs" do not include many incidentals for maintenance of shops, etc., which are really a part of the cost of repairs, but not ordinarily included in it. A chief reason for the heavy decline since 1866 is undoubtedly the continued improvement in the character of the road-bed and in the quality of the workmanship and material used.

The increase in the average miles run per engine shows an unusually favorable record, and one not likely to be much further improved on [nevertheless, it has been greatly improved on] since an *average* of nearly 100 miles per day for every day in the year and for all engines nearly reaches the possible limit It implies that single engines have more than doubled this. The decrease in miles run and simultaneous increase in cost of repairs per mile run in 1882 can hardly be an entirely accidental coincidence.

In spite of the failure of the prediction in the last paragraph, we should still be inclined to say that the present record of 40,700 miles per engine per year cannot be much improved on, even though the '84 record of 35,500 miles, which then seemed so good, has been so much improved on. There must be a limit somewhere; 15 miles per hour for every day and hour of the year would only give 131,400 miles per year, and 40,700 miles seems to approach about as closely to this limit as can reasonably be expected.

The Mica Industry.

A recent census bulletin (No. 61) shows that, in marked contrast to most other industries, there has been a decline in mica production recently. The industry advanced in importance until 1885, but since then the tendency has been downward, though the fluctuations in the production of the different regions have caused much irregularity in the annual totals. The following table does not include statistics of scrap and waste mica, as there had been no attempt prior to 1889 to determine the amount of this waste which has been utilized.

Cut Mica Produced in the United States and Value Imported.

Years.	Lbs.	Value.	Imports raw mica.
1880	81,689	$127,825	$12,562
1881	100,000	250,000	8,8.9
1882	100,000	250,000	5.175
1883	114,000	285,000	9,884
1884	147,410	368,525	28,284
1885	92,000	161,000	28,685
1886	40,000	70,000	56,354
1887	70,000	142,250	49,085
1888	18,000	70,000	57,541
1889	49,500	50,000	97,351

During 1883 and 1884, the manufacturers of stoves consumed probably 95% of the product, and the fancy grades and large sizes of sheet mica which were then used found a ready sale at highly profitable prices. Under this stimulus of large profits many surface deposits or pockets were opened by farmers or other individuals of small means, who worked them occasionally when other business was dull and realized a considerable profit on their production. As long as the demand for large sizes continued this intermittent sort of mining could be carried on with a degree of success; but when the fashion in stove panels changed, and small sheets were used in place of the large ones, the demand for the latter fell off to a great extent. The result was a great reduction in the number of producing mines. Another factor in increasing importation came into existence with the extended manufacture of dynamos and other electrical apparatus, in which a great deal of mica is used. The foreign article, especially that produced in Canada, was, on account of its superior cleavage, preferred to the domestic for this purpose; but since miners have become more fully acquainted with the qualities desired for electrical uses it has been proved that the United States can produce mica for this purpose equal to any found abroad. The foreign supply, after gaining a foothold in American markets, has more than held its own, and as its tendency has always been toward a reduction in prices there has been little inducement for the outlay of capital in mica mining.

Occurrence.—Mica is one of the natural constituents of a number of the more common rocks, but the localities in which it occurs in an available form are not very numerous. It is only in New Hampshire and North Carolina that the industry has assumed at any time much importance. In the West the most important deposits are located in the Black Hills, in the neighborhood of Harteville, Wy., and in the Cribbensville district of New Mexico. The greater part of the output of 1889 was from one mine in New Hampshire.

The available deposits of mica occur in bands of coarsely crystalline granite. In these bands the three constituents of the granite (mica, feldspar and quartz) have in a measure crystallized in separate masses, and the mica is found in bunches or pockets irregularly distributed throughout the mass. The deposits are of great interest aside from their commercial importance on account of the number of rare minerals which are nearly always present. Among these are beryl, tourmaline, garnet, columbite and samarskite. In some cases one or more of these minerals is present in sufficient quantity and of such fine quality as to give value to the deposit. Some of the finest tourmalines in the world have been found at Mount Mica, near the town of Paris, Maine, in the mica deposit at that place. Tin ore is also an accompaniment of the mica deposits in the Black Hills region.

Treatment of the Crude Product.—Mica is used in two forms, sheet mica and ground mica, and the manner in which it is treated when taken from the mine depends upon the form in which it is to be used. If it is to be sold as scrap for grinding, all that is necessary is to remove the adhering fragments of quartz and feldspar and such parts of the mica as may contain foreign ingredients. If it is to be used in the sheet form, the process is much more complicated, the blocks being first split into sheets thin

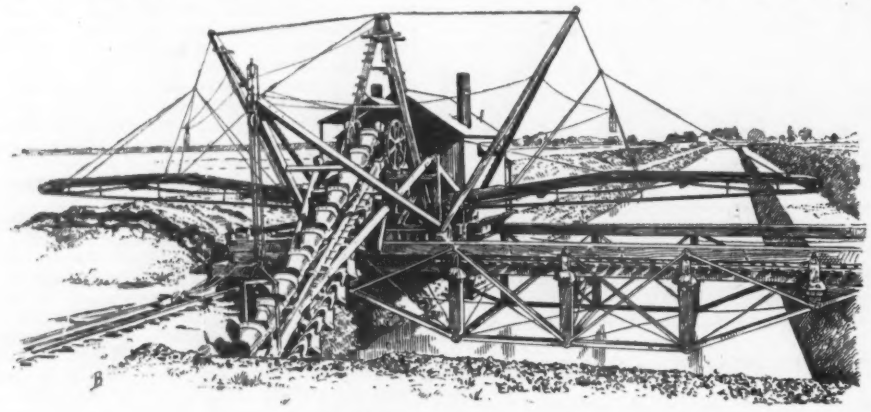
enough to cut easily, then marked with a pattern of the size desired, cut along the lines marked, and the different sizes wrapped in paper and packed for shipment. There is a great amount of waste about this operation. The amount of sheet mica obtained does not usually exceed from 4 to 8% of the block mica treated.

Uses.—The most common and well-known use for mica is in the paneling of stove and furnace doors. The most desirable color is a wine red, and next to this comes white mica, which is nearly as valuable. Another important use is in the manufacture of electrical apparatus, for which purpose its non-conducting properties render it valuable. The qualities required for this use are firmness of texture, toughness, and ready cleavage.

There is a greater range of use for ground mica than for the mineral in sheets, and though the value of that part of the product made use of in this form is small, the many peculiar properties which ground mica possesses render it quite probable that its use will be widely extended. The difficulties to be overcome in grinding mica are considerable, and there are only two or three firms engaged in the business at present. Eight standard grades of ground mica are made. The coarsest of these are used to give frosted and spangled effects to the fancy grades of wall paper. The medium grades are employed in the manufacture of a lubricant for the journals of railway carriages, for heavy bearings generally, and for the axles of road vehicles. The finest grades are used in producing a uniform metallic white surface on wall paper. Scrap mica for grinding must be white, and as free from specks or colored matter as possible, since any impurities in the scrap will affect the color and luster of the product.

A Novel Canal Excavator.

A correspondent in our issue of April 4 described a new type of canal excavator, designed and patented by the San Francisco Bridge Co., which is now digging a 6-mile irrigating canal in Colusa Co., Cal.



A NOVEL CANAL EXCAVATOR.

The accompanying engraving shows the machine at work. As seen, it consists of a deck-truss bridge or traveler, which spans the canal and runs on tracks along each bank. A track also runs the length of this bridge, and on it is carried the excavator. This consists of a dredging arm carrying an endless chain of buckets. The material brought up by these is deposited on an endless-belt carrier running over a boom, and is thus carried out and dumped on the spoil bank. The excavator can be moved lengthwise along the bridge to carry the dredging arm across the width of the canal; and the material is delivered to the spoil bank on either side as desired. The canal shown in the illustration is 100 ft. wide and 20 ft. deep. The excavator can be mounted on a barge if desired, instead of on a bridge. The weight of the excavator is 300 tons and its capacity is 100,000 cu. yds. per month. Its cost is given as $60,000.

The New Water Supply for Butte, Mont.

The Butte City Water Co. was granted a franchise for works on May 2. The company was organized in April, 1891, with 9 trustees to serve for three months, among whom were Messrs. J. F. MOFFETT, Syracuse, N. Y.; CHESTER B DAVIS and W. I. MCCORMICK, Chicago; A. D. LORING, Boston, and N. C. RAY, of Butte. The company is a successor, by purchase, of the Silver Bow Water Co., the Summit Valley Water Co., and the Silver Bow Hydraulic Mining Co.

The Butte City Co. will take its supply from Divide and Jerry creeks. There will be a storage lake at the head of the latter, which will have a capacity of about 1,000,000,000 galls. and an elevation above the sea of about 7,000 ft. From Jerry Creek water will be piped across an intervening ravine a distance of 5 miles to the summit of the ridge between it and Divide Creek, and delivered through a 24-in. pipe into the channel of the latter stream. The maximum head at the crossing of the ravine will be 1,100 ft. Water will again be impounded in two reservoirs on two branches of Divide Creek, the combined capacity of the reservoirs to be about 400,000,000 galls. From these reservoirs about 20 miles of 30-in. pipe will extend to the city, crossing the main range of the Rocky Mts. in Deer Lodge Pass at an elevation of 5,700 ft. At the city water will be delivered to a series of reservoirs at varying elevations to regulate pressure, the reservoirs to have a minimum capacity of 20,000,000 galls. There will be about 20 miles of distributing mains and 85 hydrants. The works are to be completed so as to supply 5,000,000 galls. per day by Dec. 31, 1891, and wholly completed by June 30, 1892. Pending the completion of the works a new 50,000 000-gall. reservoir is being built on Basin Creek, and is nearly completed, while a 2,000,000-gall. Allis pumping engine has been put in to supplement the 800,000-gall. pump previously in use. The city is to pay for hydrants at the rate of $120 each per year for the first 100, $88.20 for the next hundred and $84 each for all above 200. CHESTER B DAVIS, of Chicago, is Consulting, and Ray & Leonard, Butte, Mont., are Constructing Engineers. The history of the companies whose works and rights have been bought by the Butte City Water Co., and some details regarding the previous supply of Butte, are given in our issue for Feb. 28, 1891. We are indebted to Mr. N. C. RAY, of Ray & Leonard, for the above information.

The Fast Run of the Gould Special over the Chicago & Northwestern Ry.

The fast run made from Council Bluffs to Omaha on April 22, described in our issue of April 25, has just been officially reported by the Chicago & Northwestern Ry. The run was made over the Iowa and Galena divisions of the Chicago & Northwestern Ry. The Superintendents are Messrs. M. HOPKINS, Superintendent Iowa division, and OTTO MILLER, Superintendent Galena division. The actual time of the train is given as follows:

IOWA DIVISION.

Council Bluffs to Boone, 148.1 miles; conductor, H. L. PAINE; engineer, P. PICKERING. Locomotive No. 629, built in 1886 by Schenectady Locomotive Works; cylinders, 18 × 24 ins.; 4 drivers, 63 ins. diameter.

Left Council Bluffs	6.09 A. M.
Arrived Boone	8.59 A. M.
Three stops en route, consuming	8 minutes.
Running time	2 hours, 51 minutes.
Average speed	51.96 miles per hour.

Boone to Clinton, 202.3 miles; conductor, CHAS. HOLTON; engineer, JOHN JACKSON. Locomotive No. 692, built in 1888 by Schenectady Locomotive Works; cylinders, 18 × 24 ins.; 4 drivers, 63 ins. diameter.

Left Boone (5 minutes stop)	9.04 A. M.
Arrived Clinton	1.05 P. M.
Five stops en route, consuming	15 minutes.
Running time	3 hours, 46 minutes.
Average speed	53.7 miles per hour.

GALENA DIVISION.

Clinton to De Kalb, 79.8 miles; conductor, ANDREW PURNELL; engineer, W. A. SANBORN. Locomotive No. 702, built in 1888 by Schenectady Locomotive Works; cylinders, 18 × 24 ins.; 4 drivers, 63 ins. diameter.

Left Clinton (4 minutes stop)	1.09 P. M.
Arrived De Kalb	2.38 P. M.
One stop en route, consuming	6 minutes.
Running time	1 hour, 23 minutes.
Average speed	57.69 miles per hour.

De Kalb to Turner, 28.3 miles; engineer, CHAS. OBERHART. Locomotive No. 628, built in 1886 by Schenectady Locomotive Works; cylinders, 18 × 24 ins.; 4 drivers, 63 ins. diameter.

Left De Kalb (9 min. stop)	2.47 P. M.
Arrived Turner	3.17 P. M.
Running time	30 minutes.
Average speed	56.6 miles per hour.

Turner to West Fortieth St., 25.3 miles. Engineer, WM. MOBLEY. Locomotive No. 269, built in 1882 by C. & N. W. R. R.; cylinders, 17 × 24 ins.; 4 drivers, 69 ins. diameter.

Left Turner (3 minutes stop)	3.20 P. M.
Arrived West Fortieth St.	3.45 P. M.
Running time	25 minutes.
Average speed	61.72 miles per hour.

From West Fortieth to the Chicago station, 1¼ miles, the speed was necessarily slow; 4 minutes being taken.

From Council Bluffs to Chicago, 485.3 miles, the actual time, including stoppages, was 9 hours 50 minutes, or an average speed of 49.35 miles per hour. The total time spent in stops was 50 minutes, making the actual running time 9 hours, and the average speed 53.92 miles per hour.

The heaviest grades en route are as follows: On the first locomotive stage, at Arcadia, 40.13 ft. per mile, length, 2.4 miles; at Scranton, 27.98 ft. per mile, length, 2.8 miles; at Moingona, 56.5 ft. per mile, length, 4 miles. On the second locomotive stage the heavy grades are: At Ames, 39.86 ft. per mile, length, 3 miles; at Le Granne, 37.96 ft. per mile, length, 2 miles; at Luzerne, 36.96 ft. per mile, length, 1¼ miles. On the third engine stage the grades are: At Dixon, 37 ft. per mile, length, 4 miles, and at Creston, 37.5 ft. per mile, length, about 3 miles. The train, we understand, was three cars in length.

A SUSPENDED CABLE PASSENGER RAILWAY has been projected at Knoxville, Tenn. The two supporting cables are of steel, 1¼ ins. in diameter, 1,036 ft. long and will run across the Tennessee River at an angle of 13° between anchorages. A car will be slung from these cables and be drawn up by two ⅝-in. steel cables, operated by a 14 HP. engine at the higher station. The work is being done for the Knoxville Real Estate Exchange by Mr. B. J. GOGNIEB, of Detroit.

ROLLED HOLLOW STAYBOLTS for boilers are being tried by the West Shore and other railways. They are of Tennessee iron, with a ⅛-in. hole through the center. It is stated that they are strong enough to resist the severe strains of service, and will indicate fracture, while the opening is not large enough to admit an objectionable quantity of air. These bolts are made by the Falls Hollow Stay Bolt Co., of Cuyahoga Falls, O., and are claimed to be cheaper than solid bolts with holes drilled through them. The method of manufacture is as follows: Two pieces of rolled iron of U section are laid together and wired in that position. They are then heated to a welding heat and run through rolls, and as the welded tube comes from the rolls it passes over a mandrel, which fills the interior. Before reaching the second pair of rolls it cools slightly and shrinks upon the mandrel. In the second pair of rolls it is drawn from the mandrel and the interior cleared of slag and cinder. In this way, by five operations, a hollow staybolt is obtained which has a uniform interior diameter. The material is Tennessee bloom charcoal iron and is made in lengths of about 6 ft. and ¼-in. to 1½ ins. outside diameter, with a hole from ⅛-in. to ¾-in. diameter. The subject of staybolts was discussed editorially in our issue of March 21; and other matter on this subject, including tests of hollow staybolts, will be found in our issue of April 11.

BALLAST UNLOADERS in which a plow is used should have a cable strong enough to stand any strain that may come upon it. In the Supreme Court of Indiana a suit has just been decided in which damages are recovered for injury to an employee by the breaking of a cable. It appeared that the breakage occurred when the train was on a curve; and the testimony showed only that the cable was strong enough for work on a straight track. The judge very properly held that this fact was no defense for the breakage of the cable on a curved track, where it appeared that the strain was greater and no additional safety appliances were used.

THE WHALE-BACK BARGES, designed by Capt. Alex. McDougall, of Duluth, Minn., are securing a large share of the grain traffic on the Lakes. Three barges, two of which were just off the stocks, left Duluth on May 4 in tow of a single tug and carrying 312,800

bushels of wheat, which is said to be a greater amount than was ever before taken from the head of the Lakes in a single tow. The Duluth correspondent of the *Marine News* reports about 1,200,000 bushels under charter, the bulk of which is to go in the McDougall barges. The rates of freight to Buffalo are 2¼ cts., which would make the freight on the above shipment over $7,000; but as the distance from Duluth to Buffalo by rail is nearly 1,000 miles and the weight hauled is 9,284 tons, it will be seen that even if the railways could carry freight for one mill per ton-mile, they could not compete with the water carriers.

Three new barges, which are on the stocks at the yards of the American Steel Barge Co., will be equipped with their own engines, instead of being towed.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Toledo, Findlay & Springfield.—It has been decided to build the extension of this road from North Baltimore to Findlay, O., at once. The line has been partly surveyed and nearly all of the right of way secured. It is stated that surveys will be resumed immediately. T. P. Brown, of 310 Superior St., Toledo, O., is President.

Delaware, Lackawanna & Western.—The residents of Irvington, N. J., are endeavoring to secure the construction of a branch of this road to that town. It is thought that the road will be built.

Little Falls & Dolgeville.—A force of about 200 men is now grading this 12-mile New York railway.

Adirondack & St. Lawrence.—The contract for grading the section of this road between Valleyfield, P. Q., and Malone, N. Y., 31 miles, has been let to Rogers, Fauquier & Taylor, of Montreal, P. Q. The contractors will sublet the work in short sections, to be completed Aug. 15. Work is to begin at once. Morton S. Parmlee, Malone, N. Y., is President.

Lake Hopatcong.—A meeting of the projectors of this New Jersey road will be held in a few days to complete the organization of the company and elect officers. Tracklaying is reported completed from Cedar Grove, where the road connects with the New York & Greenwood Lake Railroad, to Verona, N. J., and grading is well advanced between the latter point and the terminus. It is hoped to have the line in operation by June 1.

Lehigh Valley.—The rumor is again in circulation that this company will build a branch from Tunkhannock to Lanesboro, Pa.

Cleveland & Marietta.—The contract for building the Walhonding Valley R. R. from Kimballton to Loudonville, O., 68 miles, will be let soon. J. A. Hanlon, Canton, O., Chief Engineer.

Cleveland, Cincinnati, Chicago & St. Louis.—The surveys have been resumed on the line from Harrison, O., to Richmond, Ind., 39 miles.

Dutchess County.—It is stated that $200,000 of the $300,000 required to complete this road from Poughkeepsie to Hopewell, N. Y., have been subscribed. It is expected to secure the remainder from the citizens of Poughkeepsie.

Allegheny & Kinzua.—Grading has been begun on the 6-mile extension from Morrison to the woods, and on the 3-mile line connecting Fricks and Yagar mills. Work has been in progress for some time on the line from Vandalia into the woods, 6 miles.

Projects and Surveys.

New York, Brooklyn & Long Island.—A railway company by this name will be chartered in New York to build a railway connecting with the elevated railways in Brooklyn and running along the south coast of Long Island.

Pennsylvania.—It is stated that surveys are in progress for a railway to run from McKeesport, Pa., along the Monongahela River to Port Perry, Pa., a distance of 5½ miles. The road is stated to be in the interest of Carnegie Bros. & Co., and will connect their steel plant at Duquesne with the Edgar Thompson plant at Port Perry.

Bangor & Aroostook.—The locating surveys for this Maine railway will begin at once. It is stated that the section from Brownsville to Patten, Me., will be built this season, the $500,000 of bonds voted by Aroostook Co. being sufficient for that purpose.

Maine Shore Line.—The county of Washington, Me., will vote upon the question of guaranteeing the interest upon $650,000 of the bonds of this company May 18. The company was chartered in 1881 to build a railway from a connection with the Maine Central R. R. at Sullivan, Me., to Calais, Me., with a branch to Eastport, Me., a total distance of about 110 miles. The surveys have been completed and a portion of the right of way secured. Jos. N. Green, of Machias, Me., is the chief promoter.

Brandywine Springs.—A bill is before the Delaware Legislature incorporating a railway company by this name.

Sand Beach & Port Hope.—There is talk of building a railway from Sand Beach, Mich., on the Flint & Pere Marquette R. R. to Port Hope. The citizens of the latter place have subscribed $5,000 in aid of the enterprise.

Alpena & Hillman.—The business men of Alpena, Mich., are trying to secure the construction of a railway from that place to Hillman, Me., about 23 miles. A company has been formed with a capital stock of $50,000.

New Boston.—At a recent meeting of the stockholders of this company the organization was completed by the election of a board of directors and the following officers: President, G. A. Wason; Clerk, E. H. Wason, and Treasurer, John F. Webster. The road is to run from Parker's Station, on the Manchester & North Weare R. R., along the valley of the Piscataquog River to New Boston, N. H., about 5 miles. Surveys are to begin soon.

Plymouth & Bournedale.—At a recent meeting of the stockholders it was decided to make another survey for this railway between Plymouth and Bournedale, Mass., 22 miles. The following officers were elected: President, Wm. A. Nye; Vice-President and Treasurer, Nathaniel Morton and Clerk Chas. C. Doten.

SOUTHERN.—Existing Roads.

Paducah, Tennessee & Alabama.—The contract has been let for building the extension from Paris to Hollow Rock, Tenn., 15 miles. Work is to begin May 20 and the line is to be completed Sept. 1.

Ohio & Big Sandy.—The contracts for building 16 miles of the Louisa & Southwestern R. R., from Louisa, Ky., south, will be let soon. The work will be built in 4 sections, and is to be completed within 5 months.

Gulf & Ship Island.—W. H. Hardy, of Meridian, Miss., President, writes as follows:

The contract for the extension of this road from its present terminus, 20 miles north of Gulfport, Miss., to Hattiesburg, Miss., on the New Orleans & Northeastern R. R., 51 miles, has been let to the Tobey Construction Co., of 2023 Indiana Ave., Chicago, Ill. Men and material are in route and work of repairing the old grade will begin at once. It is expectad to begin tracklaying June 1 and to have the road completed and in operation by Oct. 1. This line was graded two years ago, and the present work consists only in resurfacing the roadbed and laying the track. The route is through an undulating country, heavily timbered with long-leaf pine. The maximum grade is 1% and the maximum curve is 4°. The principal business of the road will be in lumber, rosin, turpentine, fish, oysters, tropical fruits and general merchandise. W. W. Hungerford, of Gulfport, Miss., is the engineer in charge of work.

Fincastle & Troutville.—J. B. Powell & Co., the contractors, are pushing work on this line from Fincastle to Troutville, Va., 6½ miles.

Abbeville & Way Cross.—Surveys are in progress for the extension of this road from Abbeville to Fort Valley, Ga.

Chesapeake & Ohio.—It is reported that this company is considering the extension of the Hot Springs branch now under construction between Covington and Hot Springs, Va., 24 miles, west from Hot Springs, via Mountain Grove, Va., and Huntersville, W. Va., through Pocahontas, Webster and Nicholas counties, to a connection with its main line near Ganby Bridge. The route is through a rich mineral section.

South Bound.—This company has filed a mortgage of $2,500,000 with the Mercantile Trust & Deposit Co., of Baltimore, Md., the proceeds to be used in constructing its line from Savannah, Ga., to Columbia, S. C.

Central R. R. of Georgia.—Tracklaying on the Mobile & Girard R. R. has been completed to a point about 20 miles south of Troy, Ala., and is now progressing at the rate of ½ mile per day. It is expected to have the line completed to Andalusia, Ala., by July 1.

Western Ry. of Florida.—There is talk of extending this road from Melrose to Rochelle, Fla.

Projects and Surveys.

Chattanooga, Cleveland & Murphy.—Henry E. Colton, of Chattanooga, Tenn., President, writes as follows:

This road is projected to run from some point on the East Tennessee, Virginia & Georgia R. R., probably Cleveland, Tenn., via Murphy, N. C., to Coccoa, Ga., about 175 miles. Fifty miles have been located, and surveys are in progress on the remaining distance. The route is along the valley of the Hiawassee River, and a very favorable line has been secured; maximum grade, 23.4 ft. per mile. Nearly all of the right of way has been secured and considerable local aid has been promised or obtained. The principal business of the road will be in iron ore, marble, manganese, talc, mica and timber. John M. Blackburn, Sequachee College, Tenn., is Chief Engineer.

Thomasville, Silver Valley & Pee Dee.—A correspondent writes us that it is generally thought that this road will be located and put under contract this season. It is projected to run from Winston to Wadesboro, N. C., 99 miles.

North Carolina.—G. E. Hudgins, of Salley, N. C., is building a logging road and will purchase a dummy locomotive and light steel rails.

Central City & Sacramento.—Surveys have been made for a railway to run from Central City to Sacramento, Ky., about 13 miles.

Lacoochee & Gulf.—This company has completed the location of its proposed line from Lacoochee to Dunellon, Fla., about 45 miles.

Savannah & Colleton—A project is on foot to build a railway from Savannah, Ga., via Bluffton, S. C., to Colleton, S. C., about 23 miles.

Mobile & Western.—D. H. Campbell, of Anniston, Ala., sends us the following correction to the item published in our issue of May 2:

The first 20 miles of the Mobile & Western R. R. will be built on the old grade of the Mobile & Northwestern R. R., providing the court dissolves the injunction now in force. If the court decides against the M. & W. R. R. Co., it is intended to build a parallel line. The right of way secured is beyond the portion of the line covered by the injunction.

NORTHWEST.—Existing Roads.

Chicago, St. Paul, Minneapolis & Omaha.—Graders are at work on an extension of this road near Hartington, Neb. It is not known whether the extension will be only a local spur or whether it is the intention of the company to build the proposed extension to Yankton, S. Dak., or Niobrara, Neb.

Pacific Short Line.—It is announced that this road will be sold at public auction within 60 days.

Projects and Surveys.

Winona, Osage & Southwestern.—This company has been chartered in Iowa to build the extension of the Winona & Southwestern R. R. in the State of Iowa.

SOUTHWEST.—Existing Roads.

Omaha, Hutchinson & Gulf.—At the annual meeting recently held the following officers were elected: President, H. A. Christy; Vice-President, George K. Duckworth; Secretary, E. E. Wise, and General Manager, R. N. Archer. The question of extending the road from the Kansas-Indian Territory line to Denison, Tex., was discussed, and it was decided to begin active operations at once.

Little Rock & Memphis.—The line of the Little Rock, Hot Springs & Pacific R. R. has been located between Little Rock and Hot Springs, and the contractor's forces are on the ground ready to begin work. H. A. Schwancke, Little Rock, Ark., is Chief Engineer.

Prescott & Northwestern.—R. L. Powers, of Prescott, Ark., writes us as follows:

This road is to run from Prescott, Ark., northwest, into Pike Co., Ark., to open up timber lands. It will be about 25 miles long. Nearly all of the right of way has been secured and $8,850 has been subscribed by Prescott in aid of the enterprise. About 7½ miles have been completed and two miles more are graded. It is expected to have 20 miles in operation this fall. The road will do only a logging business at present, but it is intended to do a local freight and passenger business later.

Fort Worth & Rio Grande.—About 20 miles of the grading on the extension from Comanche to Brownwood, Tex., have been completed, and it is expected to begin tracklaying in a few days. The bridge-work is well advanced.

Projects and Surveys.

Kansas City & Independence.—The Kansas City Council has granted a franchise to this company noted in our last issue. Work is to begin within 90 days, and the road is to be completed by June 1, 1892.

Hearne & Brazos Valley.—H. L. Lewis, of Hearne, Tex., writes as follows:

The surveys for this road have begun. It is contemplated to build only 12 miles at present to accommodate the planters living along the route, but the line will ultimately extend to the mouth of the Brazos River. About 9 miles of the right of way have been secured and negotiations are in progress for the remainder. Local subscriptions of bonds amounting to $50,000 have been secured. It is not decided when contracts will be let. It is expected to have the line in operation by Sept 15. T. C. Westbrook is President, and W. P. Ferguson is Secretary, both of Hearne, Tex.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—Tracklaying on the Seattle & Montana R. R. has been commenced at the northern end, and is being rapidly pushed toward Seattle, Wash.

Denver, Apex & Western.—This road is to be completed from Denver to the Resort Grounds by September. Contracts will be let soon for the iron viaduct over the railway tracks on the Bottoms, near Denver.

Burlington & Missouri River.—Tracklaying has begun on the extension from Merino to Buffalo, Wyo.—Kilpatrick Bros. & Collins have the contract for building the branch from Minnekahta to Hot Springs, S. Dak., 14 miles, and work is in progress. The line is to be completed by July.

Great Salt Lake & Hot Springs.—The grading on the first five miles of this road has been completed, and two miles of track are laid. The rolling stock has arrived. Grading is nearly completed on the branch to Jordon River.

Projects and Surveys.

Salt Lake, Hailey & Puget Sound.—Chartered in Utah to build a railway from Salt Lake City via Lucin, Utah, and Soshone Falls, Hailey and Junction Bar, Idaho, to Boise City, Idaho, about 405 miles. The officers are: President, Wm. Burke; Vice-President and General Manager, Edmund Wilkes; Secretary, W. S. McCormick, and Treasurer, J. R. Middlemiss.

Clear Lake & Northern.—This company, which was chartered in California some months ago, has completed the surveys for its proposed line from Ukiah to Lakeport, Cal. It is stated that construction will begin in a few weeks. F. H. Long, of Lakeport, Cal., is interested.

Sevier Valley.—Chartered in Utah to build a line of railway from the terminus of the Rio Grande Western Ry. at Manti, San Pete Co., through Sevier and Circle valleys and via Fremont Pass to Parowan, Iron Co.; also a branch of 5 miles from near Salena southeast to the gypsum beds; a branch from near the line between Sevier and Pi Ute counties to the Clear Creek mines, 25 miles, and spurs or branches from near Marysvale to mines in that vicinity 20 miles in length, the length of the main

line from Manti to Parowan and the spurs named being 200 miles; also a branch line connecting with the main line near Salina, and running southeast up Salina Canyon to the Emery Co. line, and thence through Castle Valley to the Rio Grande Western Ry. between Price and Green River Stations, this line being 120 miles. The cost of construction is estimated at $20,000 per mile. The directors are: David C Dodge, A. E. Welby, William F. Colton, Geo. Goss and Robert Harkness.

Spokane & Southern.—Chartered in Washington to build a railway from Spokane, Wash., to a point on the Snake River. Among the incorporators are F. Lewis Clark, A. A. Newberry and J. M. Kinnaird, all of Spokane.

Tacoma & Puyallup.—Frank C. Ross, of Tacoma, Wash., will build a standard gage railway from Tacoma to Puyallup, Wash.

The Whatcom Road Co.—This company has been organized to build a steam-motor railway from the north boundary of Whatcom Co., Wash., to the city of Whatcom, Wash. The surveys have been completed from Linden to Whatcom, 15 miles. M. A. McPherson is President, and Young & Marble, of Whatcom, are the engineers.

Nolan Creek.—This company has completed its organization by electing the following officers: President, B. Clark Wheeler; Secretary, Porter Nelson, and Treasurer, T. G. Leyster. It was decided to bond the road for $500,000 and build at once. It is projected to run from Rio Aguila station, on the Denver & Rio Grande R. R., in Eagle Co., Colo., up the valley of Brush Creek to its source.

FOREIGN.

Oaxaca Coal.—The Mexican government has granted a concession to José Arce to build a railway from Puebla to a point on the Rio Verde, where navigation will be possible with the Pacific Ocean, with the right to build branches to coal and iron beds in the State of Oaxaca. Construction must begin within one year, 100 kilos. must be built within two years, and the whole line completed within 10 years. A subsidy of $8,000 per kilometer is granted in aid of the road.

Guadalajara Belt.—A project is on foot to build a railway from Guadalajara through Zapopan, Ahualulco, Ameca, Cocula and Sayula, and return to Guadulajara.

CITY TRANSIT.

Electric Railways.—New lines or extensions are reported as probable in the following places: Indianapolis, Ind.; Denver, Colo., address the Suburban Electric Ry. Co.; Detroit, Mich., address W. S. Sheeran, and the Detroit Street Ry. Co.; Portland, Ore., address D. W. Crowley; Atlanta, Ga., address J. Hurt; Augusta, Ga., address the Southern Investment Co.; Troy, N. Y., address the Troy & Lansingburgh Ry. Co.; Dayton, Tenn., address G. J. Morse; Stockton, Cal., address the West End Improvement Co.; Seattle, Wash., address W. H. Lynch; Buffalo, N. Y., address H. M. Watson; Boston, Mass., address the Revere Electric Street Ry. Co.

Portland, Me.—The Portland R. R. Co. has decided to erect a power plant.

Lowell, Mass.—It is reported that the Lowell Horse R. R. Co. has received permission to double-track most of their lines and to use the trolley system.

Abington, Mass.—It is reported that over $50,000 has been subscribed here for the Hatherly Street Ry. Co. If completed, the system will form a direct line to Rockland.

Little Compton, R. I.—At a town meeting on May 9 a franchise of a line was granted to Col. H. B. Sisson. The road, which will be standard gage and 13 miles long, will probably be built by the Westinghouse Electric Co., and be operated for both freight and passengers.

Greenbush, N. Y.—It is reported that the North & East Greenbush Horse Ry. has been purchased by the Albany Ry. Co., which is said to have obtained right of way over several streets at present unoccupied. The system will probably be operated by electricity.

Annapolis, Md.—F. B. Hubbell, representing Baltimore parties, has petitioned for right to build a line, offering the city 5% of the gross receipts for the franchise.

Greensboro, N. C.—The Greensboro Street Ry. Co. has received a franchise to build a line to be operated by electricity, steam or horses.

New Lexington, O.—Projects for lines to Redfield and Bristol, 5 and 3 miles distant respectively, are reported as very favorably received.

Canton, O.—It is reported that the parties interested in the proposed Massillon line have decided to join with the directors of the Canton St. Ry., in building an 8-mile line between the two cities.

Stillwater, Minn.—C. P. Gregory has been granted a franchise to construct a line to St. Paul. It is said that the necessary capital has been obtained here.

Salt Lake City, Utah.—The Salt Lake City Street Ry. Co. has applied for a franchise to operate a single and double track road on several streets; motive power to be electricity or cable.

Horse Railways.—New lines or extensions are reported as probable in Olneyville, R. I., address the Union R. R. Co.; Malone, N. Y.; Stockton, Cal.

Bath, Me.—A. H. Shaw, President of the Bath Street Ry. Co., has applied for permission to build lines on several streets.

Santa Rosa, Cal.—At a recent meeting of the subscribers to the proposed Central Ry. Co., it was voted to increase the capital stock to $25,000. The road will be either a horse, cable or electric line.

Cable Railways.—*New York, N. Y.*—The East & West Ry. Co. has been organized to build a road, probably cable, across the upper part of the city. The stockholders have authorized the directors to issue $700,000 of 5% bonds, provided it is determined to build a cable road. The President is F. M. Orton.

Dummy Railways.—*Augusta, Ga.*—The City Council has granted right of way to the Richmond Co. Belt Line R. R. Co. Work must begin within 60 days and be completed in 14 months.

Newnan, Ga.—It is reported that W. B. Berry has formed a company to build a line to Franklin.

Milwaukee, Wis.—It is reported that the Milwaukee & Wauwatosa Rapid Transit Co. will begin work on their line at once.

Elevated Railways.—*Brooklyn, N. Y.*—Application will, it is said, be shortly made for a commission to condemn the right of way for the Seaside & Brooklyn Bridge Co., and also to condemn land for a new terminus at the East River Bridge for the Brooklyn Union Elevated R. R. The new company proposes to run trains over the tracks of the Union Elevated R. R. Co. wherever practicable in its route to Fort Hamilton. The proposed route is now occupied by the Brooklyn City R. R., which is trying to introduce the trolley system.

Philadelphia, Pa.—Maps of the route of the proposed Market St. Elevated R. R. have been prepared and will be sent to bidders on application to the mayor.

New Companies.—Mattoon Street Ry Co., Mattoon, Ill.; capital stock, $50,000; incorporators, E. P. Rose, G. S. Richmond, J. B. Craig. Dederick Motor Co., Milwaukee, Wis.; capital stock, $25,000; incorporators, E. and S. Dederick, H. T. West. Independent Lighting & Supply Co., Chicago, Ill.; capital stock, $60,000; incorporators, G. P. Markham, B. A. May, E. Y. Loomis. Harvey Transit Co., Chicago, Ill.; capital stock, $150,000; incorporators, H. H. Badger, C. D. Stanwood, W. G. Wanzer. Depot Belt Line Co., Syracuse, N. Y.; capital stock, $100,000; incorporators, G. N. Crouse, W. B. Kirk, W. S. Pack and others. Colfax Electric Ry. Co., Denver, Colo.; capital stock, $50,000. Southwest Chicago Rapid Transit Co., Chicago, Ill.; capital stock, $500,000. Chicago North & South Elevated R. R. Co.; capital stock, $10,000,000. Boston Rapid Transit Construction Co., Portland, Me.; capital stock, $1,000,000. Detroit & Dearborn Street Ry. Co., Detroit, Mich.; capital stock, $100,000. Flint City Ry. Co., Flint, Mich.; capital stock, $50,000. Ottowa (Can.) Electric St. Ry. Co.; President, J. W. McRea; Secretary, D. C. Dewar. Houston Rapid Transit Ry Co., Houston, Tenn.; capital stock, $300,000; incorporators, J. T. Wilson, J. A. Patton, H. J. Wilson. Santa Monica & Soldiers' Home R. R. Co., Santa Monica Cal.; capital stock, $100,000; incorporators, W. S., E. J. and W. D. Vawter, J. W. Summerfield and J. R. Moore.

HIGHWAYS.

New York.—The authorities of Rye have appropriated $10,000 for road improvements.

New Jersey.—The township of Ridgefield, Bergen Co., which works its roads under the Road Board Act, has voted $22,183 for road repairs this year.

Pennsylvania.—The Philadelphia, Bala & Bryn Mawr Turnpike Co. will soon have completed its turnpike from the city line to Fifty-second St. Mr. James A. Logan is President. The road bill has been passed by the Senate, as amended by the House.

Tennessee.—The Board of Trade of Jackson recently appointed a special committee on gravel roads, and the committee has reported in favor of issuing bonds for $200,000.

Alabama.—The Board of Revenue of Montgomery is having surveys made for an embankment across Cotoma Creek swamp, and as soon as the surveys are completed the work of building the embankment and making a road will be let by contract. The Board has also let out by contract 15 miles of the Greenville road to be graded. Teams, scrapers and all tools will be furnished the overseer or contractor, who is allowed two regular hands, all being paid regular salaries and who will give their whole time to putting and keeping the road in order. This is an experiment, and if it proves successful the plan will be adopted throughout the county.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Hardy Co., W. Va.*—Bids will soon be asked for building a bridge over the Potomac River at Buzzard's Cove. Address County Commissioners, Hardy Co., W. Va.

Gainesville, Ga.—Bids are asked for building a bridge across the Chattahooche River, near Shallow Ford, the bridge to consist of two 125-ft. spans supported by masonry abutments and pier. Propositions will be considered for a wooden, combination or iron bridge. If wooden, the roadway to be 16 ft. wide, and if iron or combination 12 ft. wide. Address A R Smith, Gainesville, Ga.

St. Louis, Mo.—The franchise granted many years ago to the East Carondelet & St. Louis Bridge Association for a bridge across the Mississippi River at Carondelet, Mo., has, it is stated, been secured by a syndicate, which will build the structure.

Kansas City, Mo.—It is proposed to build an iron highway bridge across the Kaw River, on Kansas Ave. It will cost about $75,000.

WATER-WORKS.

NEW ENGLAND.

Freeport, Me.—The people have voted to grant a franchise to E. B. Mallett. J. S. Soule is one of a committee having the matter in charge. About 20 hydrants are proposed.

Alstead, N. H.—It is reported that the village will issue $4,000 in bonds for works.

Concord, N. H.—A new supply from Penacook Lake has been recommended. The plan includes a pumping station and distributing reservoir, and the estimated cost of the improvements is $215,000.

Lancaster, N. H.—The new company will organize May 21; capital, $40,000.

Bradford, Vt.—Works are proposed by a company.

Townshend, Vt.—Works are still under consideration. C. C. Taft, C. Q. Stebbins and H. B. Kenyon were appointed some time since an investigating committee.

Brockton, Mass.—It is reported that eight hydrant will be added.

Lowell, Mass.—Bids will be asked for a new 30-inch supply main from the Beaver Brook gate-house to the engine house. Two new boilers, 6 × 18 ft., it is reported, are wanted.

New Bedford, Mass.—The contract for a new boiler and appurtenances has been awarded to the Taunton Locomotive Co. for $12,191.

Weymouth, Mass.—The legislature has granted power to the town to issue bonds for $15,000, as an additional water loan.

Norwood, R. I.—The introduction of a supply by means of a connection with the Providence works is under discussion.

Woonsocket, R. I.—The Water Committee of the Council has recommended the appropriation of $40,000 for water-works improvements.

New Haven, Conn.—The company has been asked to extend its mains to supply the cottages at Morris Cove.

Wallingford, Conn.—A meeting is to be held to vote $50,000 for a new supply main, 16, 14 and 12 ins. in diameter, as recommended by Engineer T. H. McKenzie, Southington.

MIDDLE.

Batavia, N. Y.—A contract has been made between the village and the water company previously mentioned. C. J. Shuttleworth, Springville, represents the new company, and is also connected with the Michigan Pipe Co. of Bay City.

Holland, N. Y.—It is reported that the Holland Water-Works Co. has secured the necessary right of way, and obtained subscriptions for about one-half of the necessary capital.

Middleton, N. Y.—The proposed new mains include 10,000 ft. of 20, and about 5,700 ft. of 12-in. pipe.

New Paltz, N. Y.—W. H. Cowan, of Stamford, and others, propose to build works here. It is said that a gravity supply including a 1,000,000-gall. reservior, an 8-in. supply main and 25 hydrants is projected.

Rochester, N. Y.—An extension of the mains to East Rochester is under consideration.

Tarrytown, N. Y.—We are informed that alterations and repairs are to be made with W. C. Foster, 52 Broadway, New York, Engineer.

Brigantine, N. J.—The following is from E. Clarence Miller, Secretary, 802 Provident Building, Philadelphia:

The Brigantine Water Co. proposes to begin the construction of works June 1. Water will be pumped from an artesian well to a stand-pipe. Estimated cost, $70,000. John S. Doughty is President. Population, 150.

Hughesville, Pa.—The people have voted, 239 to 11, in favor of works.

Lancaster, Pa.—C. B. Brush, Hoboken, N. J., has recommended that the new 15,000,000-gall. reservoir be located on high ground in the west part of the city, near the Franklin and Marshall College. The sum of $150,000 has already been voted for the reservoir.

Mahanoy City, Pa.—Five hydrants and five valves will be placed and 1,000 ft. of 6 and 250 ft. of 3-in mains laid.

Morrisville, Pa.—There is talk of securing a supply from the works at Trenton, N. J., and the Board of Trade has appointed a committee to investigate.

Renovo, Pa.—The council has decided to build a dam about 60 ft. long and 10 ft. high, and lay 1,000 ft. of 8-in. cast-iron pipe to connect the reservoir thus formed with the present supply.

Frederick, Md.—Robert K. Martin, Baltimore, has recommended the construction of a 20,000,000-gall. storage reservoir and that surveys be made to determine the best location for the same.

SOUTHERN.

Lynchburg, Va.—A new pumping engine and a filtering plant are under consideration.

Fairmount, W. Va.—On May 9 $20,000 of bonds for works were voted, there being but 13 adverse votes.

Atlanta, Ga.—The Water Commissioners have reported to the City Council in favor of a new supply from the Chattahoochee River in accordance with the plans of Rudolph Hering, of New York. The plan includes a

pumping station at the river with a 4,000,000 and 6,500,000-gall. pumping engine; a 30-in. force main, 18,500 ft. long, rising 258 ft.; a 35,000,000-gall. clear water basin at the upper end of the force main; a repumping station at the clear water basin with a 4,000,000 and two 6,500,000-gall. pumping engines; a second 30-in. force main, 14,480 ft. long, rising 322 ft.; and additional filters with a daily capacity of 6,500,000 galls. The total estimated cost is $792,000. At latest reports the Commissioners' recommendation had not come before the City Council.

Valdosta, Ga.—An election is to be held to vote on the issuance of bonds for works.

West End, Ga.—This suburb of Atlanta is considering works. A supply from an artesian well is talked of. Address Mayor Nelms.

Marion, Ala.—The following is from A. F. Redd:

Works are proposed which shall pump their supply from Chaba River or wells to a stand-pipe. Population, 3,000.

Troy, Ala.—It is reported that the city is again negotiating regarding the granting of a franchize, the last franchise granted having been forfeited.

Monroe, La.—It is reported that T. M. Dilley & Son think of organizing a water company here.

NORTH CENTRAL.

Cleveland, O.—According to the Cleveland *Leader* an extension of the water-works, intake to a point 3¾ miles from the shore is proposed, the plan being to drive an 8½ ft. tunnel 2½ miles from the present intake to 50 ft. of water. The estimated cost of the new tunnel is said to be $750,000 if a submerged inlet is used and more otherwise. It is reported that the tunnel will be paid for from the revenue of the works, so that some time will be required for its construction.

Columbus, O.—The following is from A. H. McAlpine, Superintendent:

Two new 7 500,000-gall, Gaskill triple expansion crank and fly-wheel pumping engines and four horizontal return tubular steel boilers, 5 × 18 ft., have just been completed and put in operation. Both the pumps and boilers were from the Holly Manufacturing Co., Lockport, N. Y. The pumps have a guaranteed duty of 120,000,000 ft. lbs. for every 100 lbs. of coal consumed. Direct pumping will be used.

Findlay, O.—It is reported that the city will build new works The present system was put in operation in 1889, and it is probable that nothing but extensions are contemplated.

Cadillac, Mich.—It is stated that Eastern capitalists are trying to buy the company's works, which were built in 1878.

Sparta, Mich.—The capital stock of the Sparta Water Co., reported last week, is $10,000.

Danville, Ill.—The Stony Creek Water Co. has been incorporated by Louis Platt and DeWitt C. Frasier, to supply Danville and Germantown; capital, $200,000.

Dundee, Ill.—The following is from J. G. Irish, Clerk:

The corporation of West Dundee wishes bids for 20-year franchises to put in both water-works and electric lighting plants. The water-works will have 25 hydrants, and the supply will be from springs about ⅛-mile distant. The Corporation reserves the right to buy both systems at the expiration of the franchise.

Springfield, Ill.—The Water Board is considering a new 24-in. main from the river to the city and parallel with the present 18-in. main; estimated cost, $55,000. H. O. Bolles is President of the Board.

Kenosha, Wis.—The company informs us that it expects to add an artesian well and about one mile of mains this year.

NORTHWESTERN.

Sioux City, Ia.—Another reservoir is projected.

Luverne, Minn.—Bonds for works to the amount of $30,000 have been voted, 155 to 32. A pump and stand-pipe will be used.

Sauk Centre, Minn.—A filter and ¼ mile of mains are projected.

Butte, Mont.—A franchise for works has been granted to the Butte City Water Co., it having bought up the works and rights of all competing companies, except the Anaconda Mining Co. Details regarding the company and the important works to be built at once are given elsewhere in this issue.

Castle, Mont.—The Carbonate Camp Water Co. has been incorporated by D. A. Loman, J. M., Addie and others, to supply water for mining and other purposes; capital, $500,000.

SOUTHWESTERN.

Brookfield, Mo.—Local papers are advocating works.

Prescott, Ark.—The Council is considering works.

Aransas Harbor, Tex.—It is reported that a contract for electric lights, an ice factory and water-works has been let.

Crockett, Tex.—Works are talked of.

Ladonia, Tex.—The Ladonia Artesian Water-Works Co. has filed articles of incorporation; capital, $7,500.

Gallup, N. M.—E. A. Sawyer, J. J. Keegan, of Gallup, E. W. Dobson, of Albuquerque, Arnold Beecher, of Chicago, Jacob Boehm, of Denver, and others, propose to put in water-works and electric lights.

PACIFIC.

Dayton, Wash.—The contracts for works have been let as follows: 12,700 ft. of pipe, Collins & Powers, Seattle, $13,000; 600,000-gall. reservoir, Oregon Bridge Co, Portland; character not specified, to G. H. Sutherland, Walla Walla, $29,000. There will be 6 miles of mains and 50 hydrants. The $75,000 bonds were sold to Henry Krutz, Walla Walla, at 90.

Tacoma, Wash.—Two 2,500,000-gall. compound condensing pumping engines have been bought of the Northwestern Supply Co., agents for the Gordon Steam Pump Co., Hamilton, O.

Myrtle Point, Ore.—The Myrtle Point Water Supply & Manufacturing Co. has been incorporated; capital, $25,000.

Portland, Ore.—All bids for cast iron pipe have been rejected.

Martinez, Cal.—The company proposes to add 2½ miles of 4-in. mains and sink an artesian well.

Sacramento, Cal.—The Colton Terrace Water Co. has been incorporated; capital, $54,000.

FOREIGN.

Chihuahua, Mex.—G. H. Utter, Silver City, N. M., has sent the following:

A company will be organized under the laws of New Mexico to build works under a franchise granted the above. The works are estimated to cost $300,000 and correspondence with capitalists is solicited. Gaskill pumps will be used.

ARTESIAN WELLS.

Gettysburg, Pa.—The Gettysburg Water Co. proposes to sink another well.

Federal Point, Fla.—E. S. Hubbard will sink a 3-in. well by hand. It is said that if he is successful others will put down wells.

Macon, Ga.—A boring for a well at a brewery here has been abandoned by the contractor after attaining a depth of 1,600 ft. It is hoped that some one will be found who will carry on the work.

Elkhorn, Neb.—A. J. Poppleton proposes to sink a well at his ranch.

Lexington, Mo.—The Lexington Water Co. proposes to sing a 6-in. experimental well 300 ft. deep.

Corsicana, Tex.—It is reported that Alderman R. E. Prince and S. Smith, of the artesian well committee, wish bids for a well.

Texas.—Wells are projected at Elgin, Hamilton and Valley Mills.

Toronto, Ont.—A correspondent of the *Globe* advocates the sinking of wells at Holland Landing for a new water supply. A reservoir and pump would be necessary.

IRRIGATION.

Lexington, Neb.—A canal 30 miles long, from a point near Lexington to Western is projected; estimated cost, $300,000.

Huron, S. Dak.—Press dispatches from this place state that the New York Land & Irrigation Co., through C. W. Barringer and A. W. Wilmarth, have bought 85,000 acres in the James River Valley which they propose to irrigate with water from artesian wells.

Green River, Utah.—The Green River Fruit & Land Co., of Denver, proposes to construct a ditch 25 to 30 miles long.

Fort Sumner, N. M.—The Bosque Redondo Irrigation Co. has located about 12 miles of its proposed 35-mile ditch and has selected a reservoir site. The ditch will start from the east side of the Pecos River, 10 or 12 miles above Fort Sumner. As projected it will be 15 ft. wide and reclaim about 40,000 acres.

North Yakima, Wash.—C. P. Rockwood, of North Yakima, Chief Engineer of the Northern Pacific, Yakima & Kittitas Irrigation Co., informs us that two trunk canals are projected, one 60 miles long to irrigate 65,000 acres, and the other, 116 miles long, to cover 148,000 acres. Construction of the shorter canal is now in progress and it is expected that work upon the longer one will begin in September. Walter N. Granger is General Agent for the company. W. H. Hall, San Francisco, should have been accredited as Consulting instead of Chief Engineer in our issue of April 25.

Spokane, Wash.—It is reported that Dr. Elmer proposes to irrigate 4,000 acres of land by pumping water from the Columbia River, the pumps to be located on a scow in the river.

Modesto, Cal.—The Modesto and Turlock Irrigation Districts propose to construct a joint dam of masonry of considerable size. E. H. Barton will be Constructing Engineer. C. S. Abbott is Secretary of the first and R. M. Williams of the second-named district. About 10,000 bbls., and perhaps more, of Portland cement will be required.

San Diego Co., Cal.—It is reported that a company is to be formed to construct a dam and works to irrigate land in the Otay, South San Diego, Highland, and Tia Juana districts; also that E. S. Babcock, Frank A. Kimball, and Walston H. Brown & Bros., of New York are interested, and a company will be formed with an authorized capital of $2,500,000, of which $800,000 will be paid in at once.

SEWERAGE AND MUNICIPAL.

Sewers.—*Maine.*—Bath has made an appropriation for sewers.—Augusta. An agitation in favor of a sewerage system has been started. The city engineer is preparing a report on the matter.

Vermont.—Rutland. Sewers are under construction. Mr. Ellsworth is Street Commissioner.

New Hampshire.—Keene. A surface water sewer is to be built under Roxbury St. to Beaver Brook.—Laconia. It has been voted to establish a system of sewerage at a cost of $100,000. A Sewer Committee has been appointed.

Massachusetts.—Malden. The council has recommended an appropriation of $3,000 for plans and estimates preliminary to entering the metropolitan sewerage system.—Middleboro has appropriated $20,000 to commence its sewerage system.—Quincy. An act has been passed authorizing the city to construct a system.

Rhode Island.—Providence. The Board of Sewer Commissioners has presented an ordinance provided for an appropriation of $15,500 for land for sewage filtration.

New York.—Glens Falls. The Sewer Committee has engaged Mr. S. E. Babcock, of Little Falls, to make a plan for a system.—Rome. It is proposed to bond the city for sewers, and a committee has been appointed to confer with the State Board of Health.—Troy. Mr. Palmer C. Ricketts, engineer for the Public Improvement Commission, has made a report in favor of the use of pipe for sewers. Plans have been prepared for about 17,500 ft. of 12, 15, and 18-in. pipe sewer, and about 2,200 ft. of brick.—Far Rockaway. Mr. C. C. Brown, of Schenectady, has examined and approved the plans for sewerage on behalf of the State Board of Health. The plans were prepared by Mr. Thomas D. Smith.—Port Jervis. Mr. Wm. B. Landreth, of Schenectady, has been engaged by the Sewer Commissioners to take charge of the construction of a system of sewers upon plans prepared by Mr. H. C. Landon, of Port Jervis, and not to prepare the plans, as stated last week.

New Jersey.—Bridgeton. Reports on a sewerage system have been made to the Sewer Committee by Mr. Rudolph Hering, Mr. Howard Murphy and Mr. Waring.—Orange. The contract with Mr. C. P. Bassett as engineer for the new system has been approved. Specifications have been prepared and proposals will be advertised for. Construction will be carried on in sections.

Pennsylvania.—Kittanning. A sewerage system is contemplated.

Virginia.—Roanoke. Appropriations amounting to $421,000 have been made for public improvements, including $150,000 for sewers and $150,000 for streets.

South Carolina.—Greenville. The sewerage question is being discussed. The cost of a system for the principal streets is estimated at $15,000 to $20,000.

Georgia.—Macon. Mr. Henry Horne, representing a company, has made a proposition to establish a sewer system.

Ohio.—Weston. Sewers are to be built.—Ironton. Mr. Rudolph Hering will prepare plans for the proposed system.

Illinois.—Belleville. The Mayor has recommended the engagement of an engineer to prepare plans and estimates for sewerage.—Harlem. The proposed system will cost $600,000. Work will be commenced soon.

Colorado.—Denver. The lowest bid for the North Denver sewer extension was from B. A. Harbour & Co. $13,150. The extension will be 1,800 ft. long and 24 ins. diameter.

Streets.—*Maine.*—Bath has made an appropriation for street paving.

Pennsylvania.—Butler. The council is receiving bids for 10,300 ft. of curbing and 13,600 sq. yds. of brick pavement.

Maryland.—Baltimore. Mr. Sams has introduced an ordinance providing that a tax of 25 cts. be inserted annually in the levy, by which $500,000 may be raised each year to be used for improved street pavements. The streets to be paved shall be designated by the Mayor, City Commissioner and Commissioner of Health, who shall also decide what pavement shall be used.

West Virginia.—Huntington. The council committee on paving has reported in favor of vitrified red pressed brick for paving, on a bed of broken stone, and with pitch poured into the joints.

Tennessee.—Memphis. There will be 20,087 lin. ft. of paving done this season, including 2,221 sq. yds. of brick, 33,659 of stone, and 51,858 of gravel. Estimated cost, $78,862.

Ohio.—Chillicothe. The city engineer has recommended fire-brick paving on 2 ins. of sand and 8 ins. of concrete, at a cost of about $1.75 per yd.—Avondale. Brick paving is to be laid.

Iowa.—Des Moines. A considerable amount of paving and street improvement is to be carried.

Parks.—The Park Commissioners of Louisville, Ky., will spend $100,000 on small squares in the interior part of the city. Buffalo, N. Y., will spend $200,000 for South Park lands. Brooklyn, N. Y., proposes to issue bonds for $500,000 for a park on Ridgewood heights. The Park Committee of Paterson, N. J., will issue $15,000 in bonds for park improvement.

Bonds.—Tacoma, Wash.; $100,000 for parks. Paterson, N. J.; $15,000 for parks. Asheville, N. C.; $500,000 for street paving, $100 000 for sewers. Los Angeles, Cal.; $320,000 funding bonds, proposals to be received until June by the city treasurer. Omaha, Neb.; $50,000 for paving, and $100,000 for sewers. Chattanooga, Tenn.; $250,000 for streets and sewers. Wellsboro, Pa.; $10,000 for street improve

ments. Boise City, Idaho; $90,000, for sewers and public buildings. Providence, R. I.; $4,000 000. Columbiana, O.; $25,000 for streets. Laconia, N. H.; $100,000 for sewers.

ELECTRICAL.

Electric Light.—New plants or extensions are reported as probable in Central Falls, R. I.; Colorado, Tex., address the Colorado Electric Light Co.; Union City, Tenn.; Mt. Airy, N. C., address the Granite City Land & Improvement Co.; Jackson, Tenn.; Gallup, N. Mex., address W. F. Reichenbecker; Covington, Ky., address E. F. Abbott; Anniston, Ala., address the Anniston Gas & Light Co.; Uvalde, Tex.; Mineola, Tex.; Palatka, Fla.; Caribou, Me. address the Caribou Water Co.; Dundee, Ill., address J. G. Irick.

Mayville, N. Y.—The town has contracted with a local company to furnish 12 arc lights, burning until 12 every night, except in July and August, when they are to run until 1 A. M. Annual cost on a 5-year contract is $576.

Greenwich, N. Y.—It has been decided by a vote of 87 to 45 to make a 5-year contract with the Electric Construction Co. to light the streets with 30 arc lights burning until 3 A M., 22 nights per month, for $1,500.

Newport, Ky.—The Suburban Electric Light Co. has a contract for 108 arc lights at $8.33 per light per month.

New Companies.—Hagerstown Heat & Light Co., Hagerstown, Md.; capital stock, $35,000; incorporators, E. W. Mealey, C. F. Manning, W. L. Hammond, of Philadelphia. Carbondale Electric Co., Carbondale, Ill.; capital stock, $5,000; incorporators, R. D. Bradberry, G. W. Graham, W. A. Schwartz. Union Electric Co., Wilmington, Del.; capital stock, $50,000; to manufacture dynamos and engines. Union Electric Works, Chicago, Ill.; capital stock, $50,000. Sanitary Appliance & Electric Co., Chicago, Ill.; capital stock, $25,000. Waterford (N. Y.) Electric Light & Power Co.; capital stock, $30,000. Cincinnati (O.) Electric Subway Co.; capital stock, $100,000. Rogers Park (Ill.) Light, Heat & Power Co.; capital stock, $75 000; incorporators, H. E. Keeler, N. A. Partridge, G. W. Wilbar. Put-in-Bay (O.) Electric Co.; capital stock, $50,000; incorporators, G. H. Ketchum, N. H. Swayne, J. H. Doyle.

CONTRACTING.

New York and Brooklyn Bridge.—The following proposals were received May 11, by the Bridge Trustees for the extension of the roadways at the New York station, and of the railway platform at the Brooklyn station. The bidders were as follows: *A*, Phœnix Iron Co.; *B*, Corfode & Saylor; *C*, Edge Moor Bridge Works; *D*, King Iron Bridge Co.; *E*, Pennsylvania Steel Co; *F*, New Jersey Steel & Iron Co.; *G*, Keystone Bridge Co.; *H*, Passaic Rolling Mills; *I*, Elmira Bridge Co.; *J*, Pittsburg Bridge Co.

	Quantities.		A		B		C		D		E		F		G		H		I		J	
	New York.	Brooklyn.	N.Y.	B	N.Y.	B.	N.Y	B.	N.Y.	B.	N.Y.	B.	N.Y.	B	N.Y.	B.	N.Y.	B.	N.Y.	B	N.Y.	B.
	lbs.	lbs.	cts.	cts.	cts.	cts	cts.	cts	cts	cts.	cts.	cts	cts	cts	cts	cts	cts	cts.	cts.	cts.	cts	cts.
Girders and connections, steel	291,000	2,267,400	3.3	3.25	3.47	3.4	3.38	3.35	3.7	3.7	3.54	3.29	3.86	3.94	4.16	4.25	4 25	4.05	3.84	3.84	3 8	3.675
Rolled beams, steel	149,200	.....	3.4	....	3.6	..	3.9	....	3.7	....	3.65	....	3.35	...	4.2	....	4.0	..	4.5	....	3.85	.....
Columns and braces, *steel	31,700	322,600	3.85	3.8	3.77	3.77	4 05	....	4.2	4.2	3.9	4.06	.....	.....	4.95	4.97	.....	.....	.....	.....	4.04	3.915
" " " †iron	"	"	3.8	3.75	3.77	3.77	3.87	3.78	4.1	4.1	3.99	3.99	4.21	3.98	4 65	4.7	4.25	4.05	4.5	4.5	3.91	3.815
Arch ties, iron	9,000	52,900	3.3	3.25	3.2	3.2	5.0	5.0	3.55	3.55	3.06	3.06	4.69	4.58	4.34	4.4	4.0	4.05	4.9	4.0	3.05	2.925
Coping, cast iron	145,000	.....	2.5	....	2.75	...	3.15	....	3.1	....	3.76	....	4.46	....	5.0	....	7 5	....	19.0	....	.....	.....
			$		$		$		$		$		$		$		$		$		$	
Total, New York. *all steel	626,000	2,642,900	19,821		20,942		22,394		22,437		22.714		25,353		28,459		30,922		34,178		.....	
" " †steel and iron	.....	.....	19.805		20 942		22,337		22,405		22,742		25,353		28,364		30,922		34,178		.....	
" Brooklyn, *all steel	.....	.....	87,668		90.946		91.345		99,320		89,313		104,597		114,725		107.037		103,701		97,504	
" " †steel and iron	.....	.....	87.507		90,946		90,797		98,908		89,087		104,597		113,854		107,037		103,701		97,181	

Stone.—Proposals for furnishing stone for the abutment of a dam in the Wabash River near Mt. Carmel, Ill., were opened April 29, by Capt. E. Maguire, U. S. Engineer Office, Louisville, Ky.: *A*, G. F. Branham, Indianapolis, Ind.; *B*, Romona Oolitic Stone Co., Indianapolis, Ind.; *C*, Dark Hollow Quarry Co., Louisville, Ky.; *D* and *E*, Salem Stone & Lime Co., Louisville, Ky., for stone of even and uneven color respectively. The quantities are as follows: 18 cu. yds. special stone, 52 cu. yds. coping, 189 cu. yds. cut stone with quarry face, 60 cu. yds, cut stone with pointed face, 235 cu. yds. squared stone, 101 cu. yds. backing.

	Sp. stone.	Coping.	Cut stone. Q. F.	Cut stone. P. F.	Sq stone.	Backing.	Total.
	$	$	$	$	$	$	$
A	10 58	10.58	9.00	9.00	7.25	6.85	5,337
B	11.50	11.50	10.10	10.10	10 10	8.40	6.541
C	12.55	11.55	11.30	11.55	9 80	8.30	6,796
D	11.00	12.25	11.00	11.00	10 65	9.60	7.046
E	12.05	12.30	12.05	12.05	11.75	10.70	7,750

Dredging.—The following proposals for dredging in the Manistee River and harbor, at Manistee, Mich., have been received by Maj. Wm. Ludlow, U. S. Engineer: C. H. Starke, 14½ cts. per cu. yd.; Green Bay Dredge & Pile Driver Co., Green Bay, Wis., 17 cts.; S. O. Dixon, Racine, Wis., 17 cts; Sheboygan Dredge & Dock Co., Sheboygan, Wis., 18 cts.; Carkin, Stickney & Cram, East Saginaw, Mich., 25 cts.

Pipe.—*Richmond, Va.*—The Water Committee has awarded the contract for 4 and 6 in. pipe to the South Pittsburgh Pipe Works, South Pittsburgh, Tenn., at $26.40 per ton; the Glamorgan Co., Lynchburg, Va., 8 in. $36.60; 10 in., $26.20, 12 and 16 in. $26. The Tredegar Co., of Richmond, Va., received the contract for special castings at 2¼ cts. per lb.

Sewers.—*Athens, Ga.*—The contract has been awarded by Mr. J. W. Barnett, City Engineer, to Howard Neely, of Chattanooga, Tenn. Laying 8-in. pipe, 20 cts. per lin. ft. earth excavation and back filling, 25, 30, 35, 40 and 45 cts., per lin. ft. for depths of 6, 8, 10, 12 and 14 ft.; hard and soft rock, 65 cts. and 20 cts. per lin. ft. per ft. in depth; manholes, $35; flush tanks, $75. There will be 5,363 ft. of earth and 2,380 ft. of rock excavation, with average cuts of 9 and 3½ ft.; 4,180 ft. of 8-in. straight pipe, 400 8-in. Y's, 12 manholes, and 4 flush tanks.

Salem, Va.—The contract for sewer material mentioned on p. 460 of our last issue under the head of Roanoke, Va., was let at Salem, Roanoke Co.

Bulkhead.—*Boston, Mass.*—The Board of Harbor & Land Commissioners has awarded the contract for building 1,345 lin. ft. of bulkhead on South Boston flats to Wm. Miller, of Boston, at $5,489.

PROPOSALS OPEN.

Street Work.—*New Bedford, Mass.*—Building Howthorn St. Wm. Sanders, County Commissioner. June 10.

Washington, D. C.—Asphalt and granite block paving, curbing, gutters and sidewalks. Also for improving various suburban roads and avenues. The District Commissioners. May 20.

Hopedale, Mass.—About 6,338 cu. yds. earth excavation, 1.562 cu. yds. screened gravel, 280 cu. yds. sidewalk gravel, 750 cu. yds. broken stone, 1,123 sq. yds. cobble paving. Board of Highway Surveyors. May 20.

Sewer.—*Warren, O.*—Main sewer in district No. 2. Geo. H. Quinby, City Clerk. May 22.

Bridges.—*Kansas City, Mo.*—Two wooden bridges, 80 and 20 ft. span. F. J. O'Flaherty, County Surveyor. May 20.

Dredging.—In Aquina Creek, Rappahannock River, and Urbana Creek, Virginia. Col. P. C. Hains, U. S. Engineer Office, Washington, D. C. May 20.

Barges.—Four mattress barges for use in building mattresses on the Mississippi River. Capt. S. W. Roessler, U. S. Engineer Office, Memphis, Tenn. May 20.

Cement.—*Cincinnati, O.*—Hydraulic Portland cement 1,000 bbls.; American natural cement, 6,000 bbls. Major J. W. Lockwood, U. S. Engineer Office. June 1.

Public Buildings.—*Oconto, Wis.*—County courthouse of brick and stone, cost not to exceed $25,000. Board of Oconto County Supervisors. May 25.

Marysville, Kan.—Fireproof county courthouse. James Montgomery, Clerk of Marshall Co. June 3.

Orlando, Fla.—Courthouse. Architect, A. S. Wagner, Williamsport, Pa. J. N. Bradshaw, Clerk of Orange Co. Court. June 1.

Washington, D. C.—Plate girders, rolled beams, wrought and cast-iron work, etc., for Congressional Library. B. R. Green, Engineer and Superintendent. May 26.

Cranes.—Two 40-ton cranes for navy yards at Norfolk and Brooklyn. Bureau of Yards and Docks, Navy Department, Washington, D. C. June 17.

Boilers.—*Cincinnati, O.*—For 4 steel boilers 5 ft. diameter and 24 ft. long, 5 boilers 4 ft. 4 ins. diameter and 24 ft. long, and 2 boilers 5 ft. 2 ins. diameter and 28 ft. long. Mechanical stokers. For Front St. pumping station. Willis V. Tharp, Superintendent of Water-Works; Louis Reemelin, President Board of Public Improvements. May 30.

Station.—Brick passenger station at Port Huron. W. J. Spicer General Manager Chicago & Grand Trunk Ry., Detroit, Mich. May 30.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Rhode Island Locomotive Works of Providence, R. I., have built 3 ten-wheel engines for the Boston & Maine and 3 mogul engines for South America. A mogul tank engine is being built for the International Coal Co., Cape Breton. The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 3 switch engines for the Lake Superior Terminal. The Brooks Locomotive Works, of Dunkirk, N. Y., are building several mogul engines for the Lake Shore & Michigan Southern.

Cars.—The Laconia Car Co., of Laconia, N. H., has an order for 6 passenger cars and 3 baggage cars for the Boston & Maine. The Barney & Smith Mfg. Co., of Dayton, O., is building 6 passenger cars for the Pittsburg, Shenango & Lake Erie. The St. Charles Car Co., of St. Charles, Mo., has completed 17 chair cars for the Missouri, Kansas & Texas. The Michigan Central has built a car for leveling and grading earth dumped from construction cars for widening fills, etc. The Youngstown Car Co., of Youngstown, O., has a number of contracts on hand. The Corey Car and Mfg. Co., of Chicago, Ill., has removed to 55 Fifth Ave.

Stations.—The Georgia R.R. will build a new station at Conyers, Ga. Plans have been prepared. The Akron Union Passenger Depot Co., of Akron, O., has been incorporated, with a capital stock of $100,000. The Pittsburg, Wheeling & Kentucky R. R. Co. has adopted plans for a passenger station and office building at Wheeling, W. Va., and work will be commenced as soon as the location is settled. The cost is estimated at $50,000. Plans have been prepared for a union station at Toronto, Ont.

Air Brake Indicator.—The Mason Regulator Co., of Boston, Mass., has acquired the exclusive right to manufacture a piston throw indicator for air brakes, patented by Mr. F. Robinson, Master Mechanic of the Maine Central R. R. It is said to be very simple, and indicates to a car inspector the condition of the brake piston.

Speed Recorder.—A Boyer speed recorder is in use on the engine of the South Vernon express of the Connecticut River R. R. The maximum speed is said to be from 50 to 62 miles an hour.

F. J. McCain & Bro., of Chicago, Ill., have been awarded the contract by the Keystone Bridge Co. for erecting the superstructure of a bridge for the Wabash Ry at Clinton, Ind. There will be five spans, including a plate girder draw span of 163 ft., of which we shall probably publish details. They have begun work on the Duluth inclined plane, and have about two-thirds of the iron work of the St. Paul viaduct in position.

Steam Roller.—A Harrisburg steam road roller is in use at Niagara Falls, N. Y.

Companies.—Anderson Rolling Mill Co., of Anderson, Ind.; C. B. Orvis, of Anderson, and W. Hanna and J. W. Parke, of Cleveland, O.; $100,000. Independent Lighting & Supply Co., of Chicago, Ill.; E. Y. Loomis, B. A. May and G. P. Markham; $60,000. Dunn Safety Switch Co., of Minneapolis, Minn.; President, E. P. Caldwell; $100,000. Drive Well Supply Co., of Chicago, Ill.; G. Mueller, Peter Nord and W. F. Rupp; $15,000. Hallowes Car Axle Box Co., of Jersey City, N. J.; $100,000. Bayou Rapids Navigation Co., of Alexandria, La.; President, F. M. Welch, $50,000.

Metal Market Prices.—*Rails.*—New York: $30.75; old rails, $24.50 for iron and $17 for steel. Pittsburg: $30; old rails, $24 for iron and $17.25 to $17.75 for steel. Chicago: $31; old rails, $23 to $23.25 for iron and $14.50 to $17 for steel.

Track Materials.—New York: steel angle bars, 1.7 to 1.75 cts.; spikes, $1.9 to $1.95; track bolts, 2.65 cts. with square, and 2.75 cts. with hexagon nuts. Pittsburg: splice bars, 1.85 to 1.95 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.8 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 to 2.05 for steel; spikes, 2 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $16. Pittsburg: $14 to $16. Chicago: $14.50 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 52½ on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.25 cts.; Chicago: 4.1 to 4.12 cts.; St Louis: 4 to 4 05 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.05 cts.; tees, 2.65 cts.; universal iron mill plates, 2.1 cts.: sheared steel bridge plates, 2.3 cts.; refined bars, 1.85 to 1.9 cts.; steel plates, 2.1 to 2.15 cts. for tank, 2.45 to 2.5 cts. for shell, 2.7 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.25 to 2.3 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.6 to 2.7 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, 4 to 4.25 cts.